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ABSTRACTS

of recent published material on Soil and Water Conservation

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"ABSTRACTS of recent published material on Soil and Water Conservation" is prepared in the Soil and Water Conservation Research Division of the Agricultural Research Service.

They are issued at irregular intervals, and their purpose is to bring together a summary of current published information about soil and water conservation for ready reference of those actively engaged in soil and water conservation work.

Distribution is handled by the Soil Conservation Service, the Agricultural Research Service, and cooperating agencies and institutions for their own personnel.

This is the FIFTEENTH of the publications issued under this title. Previous issues were published as follows:

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SOIL SCIENCE (Basic)

Soil Physics

Bloodworth, M. E., and Page, J. B. USE OF THERMISTORS FOR THE MEASUREMENT OF SOIL MOISTURE AND TEMPERATURE. Soil Sci. Soc. Amer. Proc. 21: 11-15. 1957.

Basic information on soil moisture availability for proper plant growth and development is essential in irrigated areas. This has practical applications for determining the rate and zone of moisture use by plants as well as the over-all irrigation requirements of crops.

It has been recognized that the thermal method of soil moisture measurement offers one of the best possibilities of being unaffected by salt in addition to covering the available moisture range with acceptable sensitivity. By using a thermistor as a combination heating element and temperature indicator, it has been found that such a unit, when cast in a porous material, serves as an accurate moisture indicating device.

Laboratory experiments indicated that this method of moisture measurement covers the available moisture range, with its greatest sensitivity near and below field capacity. The thermal units were unaffected by salt concentrations normally found in agricultural soils.

de Jong, G. De J. LONGITUDINAL AND TRANSVERSE DIFFUSION IN GRANULAR DEPOSITS. Amer. Geophys. Union Trans. 39: 67-74. 1958.

The pore system of a packed bed is represented by a system of canals in order to permit probability computations for a foreign particle carried by the pore liquid movement to arrive at a certain place in a certain time. The computations lead to explicit values for the coefficient of longitudinal and transversal diffusion. A test device is described which permits the determination of the longitudinal diffusivity. The relationship between test result and theory is discussed.

Lachenbruch, A. H. A PROBE FOR MEASUREMENT OF THERMAL CONDUCTIVITY OF FROZEN SOILS IN PLACE. Amer. Geophys. Union Trans. 39: 691-697. 1957.

A probe has been used for several hundred determinations in situ of the thermal conductivity of naturally frozen and thawed soils, snow, fresh-water ice, and sea ice in northern Alaska. The probe is about 20 inches long, one-quarter inch in diameter, and contains a small bead thermistor that is used as the temperature-sensitive element. Under normal field conditions conductivity determined with the probe is reproducible within about two percent. The absolute accuracy of the instrument is estimated to be within five percent. Results obtained with this probe have suggested a modification in design that is expected to offer a practical method for determining simultaneously the thermal conductivity and thermal diffusivity in situ.

Raney, W. A., and Thorne, M. D. THE USE OF RADIOISOTOPES IN SOIL PHYSICS RESEARCH. Atomic Energy and Agr., Amer. Assoc. for the Advancement of Sci.

Methods involving radioisotopes are comparatively new and have not yet been thoroughly tested, but they appear to offer advantages not previously attainable. Instrumentation improvements are urgently needed and undoubtedly will be forthcoming if present indication of basic advantages of the methods are borne out.

Schiff, L., and Johnson, C. E. SOME METHODS OF ALLEVIATING SURFACE CLOGGING IN WATER SPREADING WITH EMPHASIS ON FILTERS. Amer. Geophys. Union Trans. 39: 292-297. 1958.

Methods of preventing or alleviating clogging of soil pores when spreading water on soil surfaces or injecting water into aquifers for recharge are discussed. Observations of methods such as suction cleaning or scraping to remove clogging materials and restore the infiltration rate in some installed systems are pointed out. Certain past experimental work on the subject is reviewed.

Of various filter materials used in infiltrometers at Bakersfield, sand ranging in size from 0.5 to 1.6 mm maintained a higher infiltration rate than 1/8 or 1/4 inch pea gravel or the existing aquifer material. Information is given on particle size distribution of both the filter and aquifer materials. Head losses due to filters and within the underlying aquifer are shown.

Soil Chemistry

Arrhenius, O. THE CHEMICAL DENUDATION OF THE SOIL. Tellus, Vol. 4, 1952, pp. 307-310. Stockholm, Sweden.

The chemical denudation plays a greater role in our climate than the mechanical erosion. The Swedish well waters contain 3-4 times more soluble salts than those rivers which are fed by them. The chemical denudation therefore must be much greater than formerly calculated. A map shows the salt concentration of the well waters of Sweden. The amount of nitrogen accumulated per annum in a district of central Sweden seems to amount to 3-6 kg N per har.

Broadbent, F. E. SOIL ORGANIC MATTER-METAL COMPLEXES: II. CATION-EXCHANGE CHROMATOGRAPHY OF COPPER AND CALCIUM COMPLEXES. Soil Sci. 84: 127-131. 1957.

Soil organic matter preparations in the acid form were placed in chromatography columns and a thin layer of copper- or calcium-saturated sample poured on top. The columns were then leached with hydrochloric acid in successively higher concentrations and the effluent analyzed for the cation in question. Plots of cation concentration vs. volume of effluent showed four peaks with copper and two with calcium. A broad initial peak common to all the chromatograms was shown to be due to carboxyl retention, since it was the sale peak obtained with a carboxyl-type synthetic resin exchange. The data suggest retention of copper by groupings which do not combine with calcium.

Eck, P., Drake, M., and Steckel, J. E. CALCIUM UPTAKE BY TOMATOES AS INFLUENCED BY NATURE AND PERCENT OF CALCIUM SATURATION OF Ca-H-CLAY SYSTEMS. Soil Sci. 84: 145-154. 1957.

Kaolin at both 45 percent and 90 percent Ca saturations was a better supplier of Ca from a Ca-H system to tomato plants than Wyoming bentonite at 45, 60, 75, or 90 percent Ca saturation. Not until saturation exceeded 75 percent did the Ca ion uptake by tomato from Ca-H bentonite increase appreciably. These results agree with the activity data for Ca obtained by McLean and Marshall for the Ca-H bentonite system. No increase in Ca uptake was obtained by increasing Ca saturation on kaolin.

Fried, M., Hagen, C. E., Saiz del Rio, J. F., and Leggett, J. E. KINETICS OF PHOSPHATE UPTAKE IN THE SOIL-PLANT SYSTEM. Soil Sci. 84: 427-437. 1957.

The rate of formation of soil solution phosphorus was compared with the rate at which phosphorus is absorbed by the plant from soil solution.

The rate of formation of soil solution phosphorus for a Bridger, Caribou, and Nibley soil was at least 13-15 pounds per acre per hour. The rate at which phosphorus is absorbed by one acre of plants is less than this rate of formation by a factor of at least 250.

Lag, J. OBSERVATIONS ON OVERDISPERSING IN THE PREPARATION OF SOIL SAMPLES FOR MECHANICAL ANALYSIS. The Royal Agr. College of Norway, Vollebekk. 1953.

The mechanical analysis of pulverized soft rocks has shown that the usual method of dispersing soil material can lead to the formation of considerable amounts of new primary particles in the silt and clay fraction.

Lynch, D. L., Wright, L. M., Hearns, E. E., and Cotnoir, L. J., Jr. SOME FACTORS AFFECTING THE ADSORPTION OF CELLULOSE COMPOUNDS, PECTINS, AND HEMICELLULOSE COMPOUNDS ON CLAY MINERALS Soil Sci. 84: 113-126. 1957.

In this experiment cellulose compounds of ranging viscosity, pectins, and hemicellulose compounds were adsorbed on clay minerals. Two pectins differing in methoxy content were used to determine if the carboxyl group was concerned with the mechanism of adsorption on kaolinitic and montmorillonitic clays. Apple pectinate was adsorbed and then extracted from these clays using ammonium acetate and fluoride. Carbohydrate-protein mextures were added to calcium montmorillonite and their adsorption determined.

The higher molecular weight cellulose compounds--methylcellulose and hydroxyethylcellulose--were adsorbed in smaller amounts than those of lower molecular weight. More of the low methoxy pectin was adsorbed by all the clays. More apple pectinate was extracted from the clays by the fluoride than the acetate. The results obtained with the methoxy pectins and the fluoride extractive indicate that pectins are held on the anion exchange sites of clays or through a calcium linkage in much the same manner as that postulated for phosphorus. Proteinaceous compounds were found to be adsorbed more readily and in greater amounts by clay minerals than carbohydrate materials from a protein-carbohydrate mixture.

Soil-Plant-Animal Relationships

Anderson, E. W. SOME SOIL-PLANT RELATIONSHIPS IN EASTERN OREGON. Jour. Range Management, Vol. 9, No. 4, pp. 171-175. July 1956.

Eastern Oregon is divided into broad homogenous natural subdivisions based on specific soil-plant relationships. The factors involved include soil, type of vegetation, slope, and the like.

Colo. Agr. Expt. Sta. SOIL, WATER AND PLANT RELATIONSHIPS UNDER IRRIGATION. Col. Agr. Expt. Sta. Gen. Ser. Paper 669. 1957.

The experimental drainage well has been effective in controlling the water table in an area of at least 200 acres in its vicinity. This success has been due to the fact that an opening in the clay layer exists in this vicinity. A drainage well in any part of the lower valley can be successful only if such an opening exists in its proximity. Therefore, it is essential that investigation of the clay layer overlying the aquifer be made prior to installing any such well.

In the experimental area, the well has been operated intermittently over the past two years. The water table has been adequately controlled by pumping only during the irrigation season. The rise of the water table during the non-irrigation season is comparatively slow, so that the lower water level can be maintained on a year-around basis by pumping only part of the year.

Peck, N. H., Vittum, M. T., and Miller, R. D. EVAPOTRANSPIRATION RATES FOR ALFALFA AND VEGETABLE CROPS IN NEW YORK STATE. Agron. Jour. 50: 109-112. 1958.

Maximum average evapotranspiration rates in inches per day over 10-day periods for irrigated peas, alfalfa, tomatoes, sweet corn and cabbage grown on Kendaia and Lima silt loams were 0.19 (late June); 0.19, 0.21, 0.21 (late July) and 0.17 (mid-August) respectively.

Soil Genesis, Formation, Classification, and Mapping

Drew, J. V., and Tedrow, J. C. F. PEDOLOGY OF AN ARCTIC BROWN PROFILE NEAR POINT BARROW, ALASKA. Soil Sci. Soc. Amer. Proc. 21: 336-339. 1957.

The Arctic brown profile forms on the medium and coarse textured material of well-drained sites in the Alaskan Arctic Slope. The profile shows an accumulation of organic matter in the A_1 horizon, a weak translocation of Fe, Al, and Mn, and an accumulation of fines in the surface horizon, probably resulting from aeolian activity. Organic matter decreases from 11.48% in the A_1 horizon to less than 1% in the A_2, A_3, and C horizons, and the strongly developed profile colors are thought to be due primarily to this organic matter distribution. C/N ratios of the organic matter vary between 16:1 and 18:1. Base saturation is very low in the surface layer but increases with depth, and free carbonates are present in the lower horizons. Clay composition consists mainly of 2:1 layer silicates with small quantities of kaolinite. No authigenic weathering of primary minerals was detected.

Fragmental data indicate that Arctic brown soil forming processes may operate in other tundra and alpine regions of the world.

Kunze, G. W., and Oakes, H. FIELD AND LABORATORY STUDIES OF THE LUFKIN SOIL, A PLANOSOL. Soil Sci. Soc. Amer. Proc. 21: 330-335. 1957.

The Lufkin soil is an extreme type of clay pan Planosol found in a warm-temperature humid climate and is developed in moderately clayey sediments of deltaic and marine origin. It occupies mainly, smooth erosional upland with gradients dominantly less than 2%. The solum is composed of a relatively thin A_1 horizon with an erratically developed thin, vesicular A_2 resting abruptly on a dense subsoil of clay loam to clay texture.

Analyses were made on four profiles for particle size distribution, pH, organic matter, cation-exchange capacities, exchangeable cations, surface area, and mineral composition.

The $< 2\mu$ fraction in the B_{21} horizons was found to range from 35 to 48%. The largest amount of fine clay ($< 0.2\mu$) occurred in the B_{21} horizons. Montmorillonite dominated the clay fraction in all profiles investigated. Relatively large amounts of exchangeable sodium and magnesium are reported for the lower portions of each soil profile.

It is believed that eluviation of the fine clay from the A horizons with subsequent accumulation in the B horizon (illuviation) and clay formation in combination with the relatively large amounts of exchangeable sodium and possibly magnesium, plus a swelling type clay, are responsible for development of the clay pan, but which was the more important is not known.

Shrader, W. D., Riecken, F. F., and Englehorn, A. J. EFFECT OF SOIL TYPE DIFFERENCES ON CROP YIELDS ON CLARION-WEBSTER SOIL IN IOWA. Agron. Jour. 49: 254-257. 1957.

Several different methods of evaluating the relative effects of soil type differences on crop yields obtained in a long time rotation-fertility experiment at the Agronomy Farm, Ames, Iowa, are presented. All methods of analysis used indicate that yield differences are associated with soil type differences. The relative productivity of the different soils was found to be dependent upon the crop and management system under consideration.

Univ. Fla. Agr. Expt. Sta. RECONNAISSANCE SOIL SURVEY OF KISSIMMEE AND UPPER ST. JOHNS VALLEYS IN FLORIDA. Fla. Agr. Expt. Sta. Bull. 580. Jan. 1957.

A reconnaissance soil survey was made of the Kissimmee and Upper St. Johns valleys and of the eastern portion of Martin and northeastern portion of Palm Beach counties, Florida, to provide basic data on the kinds, characteristics, distribution, extent, and use-suitabilities of soils in the Central and Southern Florida Flood Control District.

The survey shows that vast areas of native forest and prairie now used as unimproved grazing land or left idle can be brought into cultivation of adapted crops or improved for grazing if market prices and cost of land improvement make such enterprises economically feasible. Previously, heavy losses have occurred to unprotected areas during prolonged inudation of crop and pasture lands following heavy rains or hurricanes. During other periods of prolonged drought crops and animals have suffered from lack of water. Factors affecting these conditions are heavy rainfall, unevenly distributed throughout the year, large areas of nearly level terrain with slow run-off, high underground water levels, lack of fast natural drainage to the sea, and high evaporation.

Whittig, L. D., Kilmer, V. J., Roberts, R. C., and Cady, J. G. CHARACTERISTICS AND GENESIS OF CASCADE AND POWELL SOILS OF NORTHWESTERN OREGON. Soil Sci. Soc. Amer. Proc. 21: 226-232. 1957.

Soils of the Cascade and Powell series of northwestern Oregon were studied to establish the identity of their parent materials, their mode of formation, and some of their physical and chemical properties. Conclusions were based upon integrated mechanical analysis, exchangeable cation, and mineralogical data coupled with field observation.

Common to each of the soils is one or more profile discontinuities marking zones of relatively recent deposition over pre-existing soil horizons. A similar and relatively high proportion of unweathered feldspar, hornblende, glass, and other such weatherable minerals is present in the sand fractions of the upper zones of each profile. Within the clay fractions, interstratified vermiculite-chlorite is a dominant constituent of these upper horizons and the ratio of expandable layer silicates to chlorite and the concentration of kaolin increases with depth. In both soils, relative concentrations of these clay minerals change abruptly between adjacent horizons. The abrupt differences in mineral concentrations are usually accompanied by a notable shift in particle size distribution and, in one case, by a marked difference in content of free iron oxide.

Each of the profiles contains a considerable amount of relatively unstable aluminosilicate clay material. As much as 20% of the clay fraction of some horizons is dissolved as SiO_2 and the Al_2O_3 by digestion in 0.5N NaOH. Absence of gibbsite and lack of wide variation in ratio of dissolved SiO_2 to dissolved Al_2O_3 by digestion in 0.5N NaOH. Absence of gibbsite and lack of wide variation in ratio of dissolved SiO_2 to dissolved Al_2O_3 indicates the presence of allophane which has probably formed as a residue after leaching of bases from the volcanic glass present in the sand.

HYDROLOGY

General

Beaumont, R. T. A CRITERION FOR SELECTION OF LENGTH OF RECORD FOR A MOVING ARITHMETIC MEAN FOR HYDROLOGIC DATA. Amer. Geophys. Union Trans. 38: 198-200. 1957.

In forecasting runoff a reliable base period is usually needed for reference. A procedure has been derived by which an objective selection as to the best length of record can be made for computation of a moving arithmetic mean. Results are given for several records of precipitation and runoff at stations in the western United States.

Chow, V. T. FREQUENCY ANALYSIS IN SMALL WATERSHED HYDROLOGY. Agr. Engin. 39: 222-225, 231. April 1958.

Owing to construction of numerous minor drainage structures on farm lands and along highways and to accumulation of available data, there is a growing need of frequency analysis for the determination of design discharge from small watershed. The current practice of analysis is to select data as either the annual maximum values or the exceedance values. For annual maximum values, the extreme-value law and the log-probability law are most commonly used as the basis of theoretical distribution. For exceedance values, the exponential law is used. The recommended procedure of analysis is to plot the data on a probability paper and determine the frequency by the method of least squares. Since runoff data from small watershed are generally of short period of record, two methods based on the physical basin characteristics may be used for extending the frequency data beyond the period of record instead of the extrapolation practice. If the data do not exhibit a single straight-line trend on the probability paper, a tentative study has shown that they may comprise two or more populations, and consequently separation of populations would be considered in the frequency analysis.

Harrold, L. L. MINIMUM WATER YIELD FROM SMALL AGRICULTURAL WATERSHEDS. Amer. Geophys. Union Trans. 38: 201-208. 1957.

This paper presents methods of analyzing and reporting data on minimum runoff from small agricultural watersheds of 29 to 17,540 acres near Coshocton, Ohio. From 18 years of field records of precipitation and runoff, a relationship was established to provide a means of estimating, from a 46-year precipitation record, 12-month minimum runoff values for recurrence intervals of two to 100 years for this watershed size range. The actual 18-year field records of runoff were used to develop minimum runoff values for periods of one to 12 months. Seasonal occurrence of the four lowest values and the duration of minimum flow throughout the period of record were developed. Minimum five-day stream flow for months of June, July, and August for each year of record is shown. This paper does not attempt to present all the results of this study as the data would be too voluminous. Sufficient data are shown to illustrate the methods used.

Ray, W. E., and Mondschein, H. F. A METHOD OF FORECASTING STAGES ON FLAT RIVERS. Amer. Geophys. Union Trans. 39: 698-707. 1957.

In the course of daily forecasting of river stages at selected points along the Illinois and Mississippi Rivers, it has been noticed that conventional mainstem forecasting procedures proved somewhat inadequate in cases where rivers were generally flat. Such methods usually involve multiple graphical correlations of two inflow with two outflow stage values, or Muskingum routing methods. In the study reported here, an entirely new approach to the problem on the Illinois River was developed. It involved the use of a downstream stage parameter as an index of slope and channel storage, and, when used in conjunction with modifications of standard procedures for predicting discharge inflows, could more adequately reproduce the observed stage hydrograph at the upstream point. Results achieved using this new approach are demonstrated in two actual flood rises.

Climatology

Butkovich, T. R. STRENGTH STUDIES OF HIGH-DENSITY SNOWS. Amer. Geophys. Union Trans. 39: 305-312. 1958.

Various strength properties of naturally compacted high-density snows, in the density range from 0.40 to 0.75 g/cm^3 are reported. Test results are given for: unconfined double shear at various lateral pressures; ring, flexural,

$$\sigma = a(\gamma - \gamma_0) \quad \left[1 + b(\gamma - \gamma_0)^2 \right]$$

relating the various strengths σ to the density γ of snow fit all the measurements. The constants a and b are different for each strength test, while γ_0, the virtual intercept at zero strength, is constant for all tests. The results of various tests measuring the tensile strength of the snow compare favorably with each other. An attempt to apply some of the known failure rules was unsuccessful.

Chang, J. GLOBAL DISTRIBUTION OF THE ANNUAL RANGE IN SOIL TEMPERATURE. Amer. Geophys. Union Trans. 38: 718-723. 1957.

Maps of annual range in soil temperature at 10, 30, and 120 cm depths were constructed, using the data of 780 stations throughout the world. Temperature-range profile charts for 18 stations are presented and briefly discussed. The depth of invariable temperature is about ten meters in the tropics, and 15-20 m in middle and high latitudes.

Franceschini, G. A. A METHOD FOR DETERMINING THE AVERAGE PRECIPITATION BETWEEN CURVED ISOHYETS. Amer. Geophys. Union Trans. 39: 273-277. 1958.

A method is presented to enable the hydrologist to make more accurate computations, based on the isohyetal method, of precipitation volume over an area. Essentially, the method is concerned with determining the average precipitation value in areas between curved isohyets. The technique is developed for circular concentric isohyets but is extended to other cases. An overlay-nomogram is utilized for the computations.

Johnson, H. P., and Howe, J. W. EFFECT OF VARIOUS HYDROCLIMATIC FACTORS ON SNOWMELT RUNOFF. Canad. Jour. Agr. Sci. 37: 593-594. 1956.

The frequency of occurrence of infiltration rates as indicated by an infiltration index was computed from the records of the Ralston Creek watershed near Iowa City, Iowa.

Koelzer, V. A., and Ford, P. M. EFFECT OF VARIOUS HYDROCLIMATIC FACTORS ON SNOWMELT RUNOFF. Canad. Jour. Agr. Sci. 37: 578-587. 1956.

The influence of various climatic factors on snowmelt runoff was determined through 583 multiple correlations for streams in a Bureau of Reclamation multiple-purpose reservoir system located in northern Colorado and southeastern Wyoming. The use of high-speed electronic computers facilitated the solution of the equations and the determination of various statistical parameters considered indicative of accuracy. The superiority of using both precipitation and snow-survey data as primary factors was indicated. Other factors, including winter and spring temperature and melt-season precipitation, were found helpful in individual cases, but not uniformly. Investigations of factors antecedent to the snow-accumulation period revealed no significant increase in accuracy. Numerous investigations were also made of different methods of weighting the primary factors.

Moldenhauer, W. C. ANALYSIS OF RAINFALL RECORDS FOR TERRY COUNTY, TEXAS. Program and plan for Terry Soil Conserv. District, Terry Soil Conserv. District No. 151.

In summary, the prospects for dry-land cotton production in Terry country are very dim if the present drouth continues. At this time there is nothing to indicate that the situation is improving or is likely to improve in the near future.

Sartz, R. S., Trimble, G. R., Jr. SNOW STORAGE AND MELT IN A NORTHERN HARDWOODS FOREST. Jour. Forestry 54(8): 499-502. Aug. 1956.

This study indicates that snow accumulation in hardwood forests can be increased and melting of the snow pack prolonged by cutting narrow openings in an east-west direction. The width of the openings that would do this most effectively depends on the latitude, aspect, slope percent, and height of the trees.

Land Use Influences

Stoddard, C. H. UTILIZATION OF SWAMPLANDS FOR WILD RICE PRODUCTION: A PROGRESS REPORT. Jour. Soil and Water Conserv. 12: 135-138. 1957.

In northwestern Wisconsin, a 20-acre area was drained, farmed, disked, flooded, and seeded to wild rice at a direct cost of approximately $100 per acre. The first-year yields of wild rice were considerably reduced by blackbirds, but the birds were finally repelled with metallic streamers. Waterfowl were attracted to the area, and management of exploitable fish and furbearer populations seemed possible. Caution is urged in making any introduction, especially if exotic species are considered. As a land-use technique, potentially capable of paying for itself over an important part of the Lake States, this experiment points to a possible way for utilization of large areas of swampland.

Ground Water

Kaufman, W. J., and Orlob, G. T. AN EVALUATION OF GROUND-WATER TRACERS. Amer. Geophys. Union Trans. 37: 287-296. 1956.

The ideal ground-water tracer should correctly depict the movement of water through a porous medium without modifying the transmission characteristics of the system. Cationic materials, including radio-isotopes and certain organic dyes, are generally unsatisfactory and anionic radio-isotopes when used without stable carriers may be largely retained by adsorption. Chloride may be satisfactorily used where density effects can be avoided and disperson of clays is not likely. Organic materials are subject to decomposition by soil micro-organisms and hence their value as water tracers are limited. Tritium, when used as tritiated water, may exchange with soil bound water with a resulting reduction in velocity of the tracer front.

Kazmann, R. G. PROBLEMS ENCOUNTERED IN THE UTILIZATION OF GROUND-WATER RESERVOIRS. Amer. Geophys. Union Trans. 39: 94-99. 1958.

Ground-water reservoirs are compared to surface-water reservoirs and the similarities and differences are pinpointed. For example, the boundaries and storage capacity of a water-bearing formation are not readily determinable. By comparison, an aerial survey of a potential reservoir site, from which a contour map may be prepared, is generally sufficient to determine the boundaries and storage capacity of any desired impoundment. Further, ground-water reservoirs are full to start with, whereas the area of an impoundment is usually devoid of water, except for a small amount contained in the river channel. Such differences, and others discussed in the body of the paper, give rise to social and engineering problems which are not duplicated elsewhere in the field of water-resource development. It may not be an exaggeration to state that, at our present level of technique and knowledge, the scientific and engineering problems are less vexing than the problems which must be solved by negotiation and persuasion. Examples of problems encountered in the utilization of ground-water reservoirs are cited. As case histories, problems of industrial ground-water supply in the East St. Louis area, and of municipal ground-water supply in the Canton, Ohio, area are discussed.

Muckel, D. C. GROUND WATER RECHARGE INVESTIGATIONS IN CALIFORNIA. Proc., Conference on the Calif. Ground Water Situation. Dec. 3-4, 1956. Comm. on Res. in Water Resources, Univ. of Calif.

The California State Department of Water Resources is carrying on recharge investigations on a statewide basis by making a comprehensive inventory of artificial projects in the State. It has completed a detailed study at 106 active recharge sites. Measured, sustained percolation rates were collected from many of the agencies presently responsible for spreading surplus waters in California, as well as from some of the more important publications on recharging operations. The major objectives of the inventory were: (1) to determine the degree to which the supply to the ground waters of the State is augmented or maintained by artificial recharge; (2) to obtain design criteria and costs data; (3) to obtain information on operation and maintenance problems; and (4) to evaluate physical characteristics and structure of sediments as related to the determination of percolation rates.

Remson, I., and Randolph, J. R. APPLICATION OF STATISTICAL METHODS TO THE ANALYSIS OF GROUND-WATER LEVELS. Amer. Geophys. Union Trans. 39: 75-83. 1958.

Valuable hydrologic information can be obtained from statistical analysis of water-level trends. The time-series and the functional-equation approaches are applied to New Jersey well records representing different hydrologic conditions. The results are valuable as concise summaries of the records, for extrapolating observed data, for interpolating between measurements, and for estimating hydrologic factors such as coefficients of transmissibility and storage, evapotranspiration, and ground-water discharge.

Werner, P. W. SOME PROBLEMS IN NON-ARTESIAN GROUND-WATER FLOW. Amer. Geophys. Union Trans. 38: 511-518. 1957.

This paper deals with problems relating to ground-water movement in aquifers under water-table conditions, and more particularly with the unsteady flow caused by variations in some boundary condition or in the replenishment from the ground surface. The cases to be treated are diagrammatically shown; the first refers to the flow between two reservoirs, and the second to the flow between a water divide and a reservoir.

The treatment will be based on the so-called Laplace transformation method, which is useful for solving some typical cases, often met in hydrology and various fields of engineering practice. Definite formulas are established, which include the effect of a moderately sloping bottom, and the inclination of the ground-water level is also taken into consideration. Separate formulas are given for the more simple case that the bottom of the aquifer is horizontal.

SOIL AND WATER MANAGEMENT

General

Blaney, H. F. EVAPORATION STUDY AT SILVER LAKE IN THE MOJAVE DESERT, CALIFORNIA. Amer. Geophys. Union Trans. 38: 209-215. 1957.

Silver Lake is located in the Mojave Desert north of Baker, California. It was formed within a period of three days as a result of a flood in the Mojave River in March 1938. Previously the lake had been dry for several years. Its maximum size was seven miles long and three miles wide. After this flood, daily observations were made of temperature, humidity, wind movement, precipitation, and pan evaporation at a Class A weather Bureau evaporation station established adjacent to the lake, and of changes in water level and temperatures of the lake from May 1938 to April 1939. This paper presents a summary of these measurements. No inflow or outflow occurred during the study and the lake was entirely dry at the end of the following year. Borings in the tight clay lake bottom indicated there were no losses by seepage.

The purpose of the study was to determine coefficients for converting pan evaporation to lake evaporation and to develop an empirical relation between evaporation and meteorological factors, under desert conditions. The results show that annual evaporation from Silver Lake was 79 inches for the period of observation, and that a coefficient of 0.60 could be used in reducing Weather Bureau pan evaporation to lake evaporation in desert areas with similar climate.

Holmes, R. M., and Robertson, G. W. CONVERSION OF LATENT EVAPORATION TO POTENTIAL EVAPOTRANSPIRATION. Canad. Jour. Agr. Sci. 38: 164-172. 1958.

Potential evapotranspirometers and various evaporation pans are commonly used to estimate potential evapotranspiration. These instruments are expensive, large, difficult to install and use. A black Bellani plate atmometer is suggested as a simple instrument to replace these large tanks. It consists of a black, porous, ceramic plate, mounted on a glazed ceramic cup. The plate surface is kept moist by the drying ability of the air and is called "latent evaporation". Comparisons of various evaporimeters have shown the Bellani atmometer to be accurate and responsive to meteorological variables.

Latent evaporation was compared with open-pan evaporation (from a 4-foot diameter buried tank) at several sites across Canada. Latent evaporation was also compared with evapotranspiration from irrigated field plots and evapotranspirometer tanks. The conversion factor of 0.0034 inches of evapotranspiration from irrigated fields, and 0.0032 inches of open-pan evaporation for each cubic centimetre of latent evaporation has been tentatively established. Latent evaporation and moisture block methods have shown excellent agreement in scheduling irrigation.

Roberts, W. J. EVAPORATION SUPPRESSION FROM WATER SURFACES. Amer. Geophys. Union Trans. 38: 740-744. 1957.

Techniques used for measuring the effect of monomolecular films to suppress evaporation from water surfaces are reviewed. A brief history of chemical studies and field testing of organic compounds is presented. Research in Illinois by the State Water Survey indicates that normal evaporation may be reduced by as much as one-third by efficient use of monolayers.

Robins, J. S. MOISTURE MOVEMENT AND PROFILE CHARACTERISTICS IN RELATION TO FIELD CAPACITY. International Commission on Irrigation and Drainage. Third Congress.

Soil moisture storage in relation to the upper limit commonly referred to as "field capacity" is discussed in relation to unsaturated flow in field soils and to the nature of the soil profile, whether deep and uniform in texture and structure or whether discontinuities associated with density, permeability, textural, or structural differentiation within the profile.

Unsaturated flow characteristics of soils are shown to be the dominant physical phenomena affecting field capacity. The importance of energy gradients is also discussed relative to moisture condition to the profile at the time of irrigation, depth of wetting of the profile, and hysteresis effects.

The behavior of moisture movement in relation to field capacity is discussed relative to certain profile characteristics. Four general profile types are discussed; namely, the deep, uniform structural and textural profiles, profiles containing impermeable or very slowly permeable layers, profiles consisting of relatively shallow soil mantles overlying coarse-textured material, and profiles in which textural gradations from either coarse surface material to fine-textured subsoils or fine-textured surface materials to coarse-textured subsoils occur over an appreciable depth interval. In general, any profile discontinuity, whether a change from more permeable to less permeable material with depth or from finer-textured to coarser-textured material with depth or the existence of relatively impermeable material within the profile, usually increases the water retained by the profile. The effects of this increased storage within the surface soil layers is reflected not only in increased moisture storage and extended irrigation interval, but also aids in germination and seedling establishment.

Suomi, V. E., and Tanner, C. B. EVAPOTRANSPIRATION ESTIMATES FROM HEAT-BUDGET MEASUREMENTS OVER A FIELD CROP. Amer. Geophys. Union Trans. 39: 298-304. 1958.

The heat-transfer processes which occur at the Earth's surface have direct bearing on many of the physical problems in agriculture that relate to the plant environment. The evapotranspiration from a crop can be estimated from the disposition of solar and sensible energy available at the earth-air interface. A suitable measurement of the heat budget, including net radiation, heat transfer by soil conduction, air-temperature gradient above the crop, and vapor pressure gradient above the crop, will account for the fraction of solar energy used hourly or daily for evapotranspiration. The simple theory, a brief description of the experimental equipment, and some illustrative measurements are discussed.

Swartzendruber, D., and Huberty, M. R. USE OF INFILTRATION EQUATION PARAMETERS TO EVALUATE INFILTRATION DIFFERENCES IN THE FIELD. Amer. Geophys. Union Trans. 39: 84-93. 1958.

The infiltration equations $y = At^B$ and $dy/dt = a + b/y$ have appeared in the literature, where y is the quantity of water which will enter a soil when water is applied to the surface, and t is the time. In the present investigation, the constants A, B, a, and b, are considered for their usefulness in characterizing infiltration in field basins on Greenfield loamy sand, a deep soil without profile development. The product parameter AB is compared with a parameter R_T which is simply the average rate over the first two hours of infiltration. The results show AB to be 40 pct better statistically than R_T. On the other hand, a + 10b, which is superior to a alone and b alone, is essentially no better statistically than R_T.

Yamaoka, Y. EXPERIMENTAL STUDIES ON THE RELATION BETWEEN TRANSPIRATION RATE AND METEOROLOGICAL ELEMENTS. Amer. Geophys. Union Trans. 39: 249-265. 1958.

Water loss caused by transpiration is significant, especially on a bright summer day. The utilization of precipitation as a water resource will be affected largely by transpiration. Thereupon, the investigation of the transpiration rate was carried out as a fundamental datum of water resources, using a wind tunnel which can maintain any meteorological condition. Various examinations on the potometer method were performed and the method was found satisfactory in our investigations. The transpiration rate obtained by the potometer agreed with ± 2.4 pct with that of the potted plant. The following empirical formulas were obtained from the relation of the transpiration rate to radiation intensity and wind velocity for *Myrica rubra*.

$$T = T_O \mp v/(0.55 \times 10^{-1.37R} \cdot v + 0.32 \times 10^{-2.35R})$$

$$T_O = (2.09R + 1.67)H_d + 35.62R$$

Also, the relations of the leaf temperature to transpiration rate and meteorological elements were studied. Some systematic relations were found.

Fertilizers and Soil Fertility

Adams, F., and Wear, J. I. MANGANESE TOXICITY AND SOIL ACIDITY IN RELATION TO CRINKLE LEAF OF COTTON. Soil Sci. Soc. Amer. Proc. 21: 305-308. 1957.

A Kalmia fine sandy loam having a pH of 4.5 on which crinkle leaf of cotton occurred in the field was studied in the laboratory and greenhouse.

An application of $CaCO_3$ and Na_2CO_3 to the soil prevented the occurrence of crinkle leaf, whereas the addition of a neutral calcium salt did not prevent the abnormality. Water-soluble manganese in the soil was greatly reduced by $CaCO_3$ or Na_2CO_3; however, these salts had little effect on the amount of exchangeable or reducible manganese. $CaCl_2$ had little or no effect on the abundance of any form of soil manganese.

A technique was used that maintained high acidity of the soil solution while controlling the amount of manganese and aluminum in solution. By this technique, the symptoms of crinkle leaf were shown to be the result of a high level of manganese in the soil solution and not because of some other factor associated with high soil acidity.

Crinkle leaf of cotton can be expected as sufficient acidity develops in those soils that have a high potential supplying power of soluble manganese. The necessary preventive measure for crinkle leaf in the field is an adequate liming program.

Adams, F. RESPONSE OF CROPS TO LIME IN ALABAMA. Ala. Agr. Expt. Sta. Bull. 301. Dec. 1956.

The variable amounts of soil acidity and the efficiency of different liming materials make a hard and fast rule for liming impossible. The amount of lime needed to neutralize soil acidity depends upon (1) soil pH, (2) clay content, (3) type of clay, (4) organic matter content, (5) crop, and (6) kind and fineness of liming material. Using a soil test is the only reliable method of ascertaining lime needs. The soil test shows degree of acidity and amount of lime needed to neutralize that acidity.

The Soil Testing Laboratory at the Agricultural Experiment Station of the Alabama Polytechnic Institute analyzed 19,187 soil samples by the end of 1955. Of these samples, 34 percent had a pH of 5.5 or less and needed lime for even the more acid-tolerant crops, such as cotton, corn, and oats. Approximately 74 percent of the samples showed need for lime for legumes (pH 6 or less). Thus, it can be concluded that a large portion of the agricultural land in Alabama to some degree suffers from inadequate lime.

Anderson, M. S. SAWDUST AND OTHER NATURAL ORGANICS FOR TURF ESTABLISHMENT AND SOIL IMPROVEMENT. ARS 41-18, Agr. Res. Serv., U. S. Dept. Agr. Nov. 1957.

The purpose of this paper is to review the properties of some of the low-analysis organics that might be available to a gardener, examine certain data from field experiments, and consider the experiences of several users of natural organics, for turf and shrubbery in particular.

Armiger, W. H., Dean, L. A., Mason, D. D., and Koch, E. J. EFFECT OF SIZE AND TYPE OF POT ON RELATIVE PRECISION, YIELDS, AND NUTRIENT UPTAKE IN GREENHOUSE FERTILIZER EXPERIMENTS. Agron. Jour. 50: 244-247. 1958.

Containers that ranged in capacity from 1 gallon to 3 gallons were as satisfactory as larger containers for greenhouse fertility studies.

Army, T. J., and Miller, E. V. RELATIONSHIPS OF THE CATION SUITE AND YIELD OF TURNIP GREENS FOR SELECTED EXTREMES OF SOILS, FERTILIZERS, AND ENVIRONMENT. Soil Sci. Soc. Amer. Proc. 21: 176-182. 1957.

Two contrasting soils representing the kaolinitic and montmorillonite types of clay were used to study the interactions of soil type, fertility, soil temperature, and season on the growth and cation content turnip plants.

Growth was closely associated with soil calcium status and soil temperature. Growth response to soil temperature differentials was affected by season.

Cation content of the tops was markedly influenced by the exchangeable cation levels and by the predominating clay minerals of the respective soils.

Sodium, the content of which tended to decrease in the tops with and increase in soil temperature, was the only macrocation materially affected by soil temperatured. The K:Na ratio of plants was also dependent upon the soil temperature.

Aerial environmental conditions, although not individually characterized, were shown to be of equal importance to soil factors in determining cation content of plants. The magnitude of seasonal effects on cation concentration in leaves, however, was influenced by type of clay mineral and the percent Ca and Mg saturation in the soil.

The interrelationships of growth and macrocation content are discussed.

Baird, J. V. THE INFLUENCE OF FERTILIZERS ON THE PRODUCTION AND QUALITY OF PEPPERMINT IN CENTRAL WASHINGTON. Agron. Jour. 49: 225-230. 1957.

Oil quality and yield of peppermint were related to the plant nutrient status. Nitrogen, P, K, and S produced in that order decreasing influences on oil and hay yield. Menthol content of oil, especially in 1953, was decreased in those plants with increased nitrogen content, whereas menthofuran was increased. Leaf N was slightly more effective than leaf P in predicting menthol content and three times as effective in predicting menthofuran content. Menthol and menthofuran accounted for 76 percent of the variation in optical rotation of the oils in 1953. Menthol was more important in determining optical rotation in 1953.

Baker, A. S., and Cook, R. L. NEED OF BORON FERTILIZATION FOR ALFALFA IN MICHIGAN AND METHODS OF DETERMINING THIS NEED. Agron. Jour. 48: 564-568. 1956.

Many Michigan soils are relatively low in B available to alfalfa during periods when surface soils are low in moisture content. The occurrence of deficiency symptoms indicates a low level of available B and a need for B fertilization. Test results of less than 20 p. p. m. B in the top 1 to 2 inches of alfalfa or less than 0.9 to 1.0 p. p. m. soil B extractable in boiling water also indicate a need for B fertilization.

Bartholomew, W. V., Shrader, W. D., and Englehorn, A. J. NITROGEN CHANGES ATTENDING VARIOUS CROP ROTATIONS ON CLARION-WEBSTER SOILS IN IOWA. Agron. Jour. 49: 415-418. 1957.

Nitrogen declines with cultivation of Clarion-Webster soil were largest under a cropping system of continuous corn followed in the order of decreasing decline by the 2-year rotation of corn and oats, the 5-year rotation with 2 years of meadow and the 3-year rotation with 1 year of meadow. Plots with high initial nitrogen lost more nitrogen and a larger percentage of total nitrogen than plots with low initial nitrogen.

Bates, R. P., and Collier, J. W. CORN FERTILIZER TESTS AT SEVERAL LOCATIONS IN THE CENTRAL BLACKLANDS, 1953-54. Tex. Agr. Expt. Sta. Prog. Rpt. 1761. 1955.

In 1953 and 1954, under existing rainfall conditions near Thrall, 60 pounds of phosphorus increased corn yields on Bell clay and in 1954 increased yields on Houston Black clay. In 1954, nitrogen increased yields on both Bell and Houston Black clay, while in 1953 nitrogen did not affect corn yields on either soil. .Potash did not affect yields either year.

Under irrigation in the Little River bottom near Buckholts, nitrogen and phosphorus slightly increased corn yields in 1953. In 1954, 180 pounds of nitrogen increased yields from 41.6 to 122.9 bushels per acre, while phosphorus did not affect corn yields. Potash did not affect yields either year.

Bates, R. P., and Collier, J. W. EFFECTS OF FERTILIZER AND ROW SYSTEMS ON CORN YIELDS IN DIFFERENT CROPPING SYSTEMS AT TEMPLE, 1953-54. Tex. Agr. Expt. Sta. Prog. Rpt. 1794. June 4, 1955.

Corn tests on Houston Black clay and Austin clay at the Temple station in 1953-54 under adverse moisture conditions showed no response from nitrogen fertilizer following cotton, oats with sweetclover or fescue with sweetclover. Nitrogen decreased yields slightly in 1953 following cotton and oats with sweetclover. Phosphorus increased corn yeilds in 1954 following cotton and oats with sweetclover. In 1953, there was a slight response to phosphorus, but the increases were not significant. Neither nitrogen nor phosphorus affected corn yields following fescue with sweetclover.

In 1953, 8,720 corn plants per acre in a system of planting two rows in corn and skipping one row slightly outyielded the same population where every row was planted. In 1954, there was little difference between the two systems.

Bernstein, L., and Fireman, M. LABORATORY STUDIES ON SALT DISTRIBUTION IN FURROW-IRRIGATED SOIL WITH SPECIAL REFERENCE TO THE PRE-EMERGENCE PERIOD. Soil Sci. 83: 249-263. 1957.

A laboratory technique was devised for the study of salt movement in full-scale models of beds and furrows. Salt transport in furrow-irrigated saline soils results in a high concentration of salt in the wetting-front. Under the surface of the bed, salt concentration decreases rapidly behind the wetting-front or the locus of points at which the opposing fronts met. In the surface of the bed, however, salt remains widely distributed behind the front, especially in flat-topped beds. Salt accumulation in the surface layer of soil appears to be a function of the angle between the wetting-front and the surface of the bed; the more acute the angle, the greater the salt deposition on the surface layer of soil. Additional irrigation under low-evaporation conditions (that is, at night) may reduce harmful salt accumulation at the planting position, even in the center of the bed.

Brensing, O. H., and Lynd, J. Q. WHEAT FERTILIZATION ON CLAYPAN SOILS IN NORTHEASTERN OKLAHOMA. Okla. Agr. Expt. Sta. Bull. B-488. Mar. 1957.

Four years' data from comprehensive soil fertility experiments with hard red winter wheat on a claypan soil, Parsons silt loam, Craig County, Oklahoma, gave the following results:

1. Highly significant and profitable increases in wheat yields resulted from proper rates and combinations of nitrogen, phosphorus and potassium fertilization for each of the four years, 1953-1956.
2. The first limiting plant nutrient for wheat yields on this soil type was phosphorus. Highest yield increases were obtained only with adequate phosphorus application. Superphosphate applied at rates equivalent to 40 pounds P_2O_5 per acre gave the highest yield increase for a single plant nutrient addition.
3. Yield increased with additions of 20, 40 and 80 pounds nitrogen applied per acre when phosphorus and potassium were supplied in adequate amounts. The largest increases per pound of nitrogen applied were obtained at the 20- and 40-pound nitrogen rates when combined with 40 pounds P_2O_5 and 60 pounds K_2O.
4. No significant differences in yield were obtained as a result of difference in the time of nitrogen application, spring or fall.
5. Increases in yield with application of 60 pounds K_2O per acre were obtained at all rates and combinations with nitrogen and phosphorus fertilizer treatments used in this experiment.

Brown, B. A. POTASSIUM FERTILIZATION OF LADINO CLOVER. Agron. Jour. 49: 477-480. 1957.

In a 6-year experiment, smaller, frequent applications of KCl were much more effective in maintaining the stands and yields of a Ladino clover-orchard grass seeding than larger, less frequent doses.

Chichilo, P., and Whittaker, C. W. TRACE ELEMENTS IN AGRICULTURAL LIMESTONES OF ATLANTIC COAST REGIONS. Agron. Jour. 50: 131-135. 1958.

Compared to amounts of elements removed from the soil by cropping or to amounts added to soils to correct deficiencies many limestones of the Atlantic Coast Regions contain important amounts of magnesium, iron, manganese, molybdenum, sulfur and zinc at ordinary application rates. On the same basis, amounts of potassium, phosphorus, boron and copper are of much less importance.

Clark, F., Nearpass, D. C., and Specht, A. W. INFLUENCE OF ORGANIC ADDITIONS AND FLOODING ON IRON AND MANGANESE UPTAKE BY RICE. Agron. Jour. 49: 586-589. 1957.

Organic amendments in addition to flooding were injurious to rice yields and increased plant Fe uptake but decreased Mn. The Fe levels in plants grown submerged in water and unsubmerged without organic amendments were found comparable, but the submerged yields were higher and were accompanied by a Mn uptake more than tenfold of rice grown unsubmerged. Marked yield response to Mn was obtained in upland cultures. Levels of Mn found in plants indicate that rice has a high requirement for and an exceptionally high tolerance to Mn.

Cook, E. D., and Parmer, W. R. COTTON FERTILIZER TESTS AT THE BLACKLAND EXPERIMENT STATION, 1952-55. Tex. Agr. Expt. Sta. Prog. Report 1883. July 20, 1956.

Cotton fertilizer tests were conducted at the Blackland Experiment Station near Temple and on the Stiles and Priecemeyer farms at Thrall during 1952-55.

Nitrogen (N) or phosphoric acid (P_2O_5) alone did not significantly increase cotton yields. However, in most tests cotton yields were increased significantly by adding 15 pounds of N and 30 to 60 pounds of P_2O_5. No further increase in yields was obtained when 60 pounds of potash (K_2O) were added to 30 and 60 pounds of N and 60 pounds of P_2O_5.

There appeared to be no difference in the reaction of Houston Black clay and Bell clay soils to the fertilizer.

Cook, E. D., and Parmer, W. R. OAT FERTILIZER TESTS, BLACKLAND EXPERIMENT STATION, TEMPLE, 1953-55. Tex. Agr. Expt. Sta. Prog. Rpt. 1874. 1956.

A fertilizer study on oat forage production was conducted at the Blackland Experiment Station at Temple on Houston Black clay soil during 1953-55. Lack of moisture during the growing season limited forage yields each year.

In most tests, nitrogen applications significantly increased forage yields in all 3 years. Phosphorus alone significantly increased forage yields in 1954 but not in 1953 or 1955. Nitrogen and phosphorus combinations increased forage yields significantly in almost every test. The addition of 60 pounds of potash to 60 pounds each of nitrogen and phosphoric acid did not increase the yield further.

Protein content of the oat forage decreased from clipping to clipping. In 1954, the protein content decreased about 6 percent from the first clipping on March 31 to the fourth clipping on June 8. In 1955, the decrease in protein was 3 or 4 percent from March 15 to May 24. The phosphoric acid content did not change much from clipping to clipping or from year to year. There was sufficient protein and phosphoric acid at all times for livestock maintenance.

Doll, E. C., and Link, L. A. INFLUENCE OF VARIOUS LEGUMES ON THE YIELDS OF SUCCEEDING CORN AND WHEAT AND NITROGEN CONTENT OF THE SOIL. Agron. Jour. 49: 307-309. 1957.

The application of ground limestone in every instance resulted in significant increases on the yields of corn and wheat. The yields of corn and wheat following soybeans were much lower than those following the other legumes. Lespedeza compared favorably with clovers. The yields in all cases tended to increase throughout the duration of the experiment. Except for a decrease on the plots on which soybeans were grown for hay, soil nitrogen was maintained at, or near, the original level.

Eck, H. V., Stewart, B. A., and Boatwright, G. O. ANHYDROUS AMMONIA AND AMMONIUM NITRATE FERTILIZERS FOR WHEAT. Okla. Agr. Expt. Sta. Bul. No. B-493. 1957.

These experiments were conducted over a rather short period of time, at only a few locations, and during a period of extreme drouth conditions. The results do not give conclusive answers to all of the questions set up in the objectives but they do furnish some useful information. The results of Experiment I indicate that anhydrous ammonia is as efficient a carrier of nitrogen for wheat as ammonium nitrate. In fact, in some instances anhydrous ammonia was slightly more efficient than ammonium nitrate. The slight advantage for anhydrous ammonia could have been due to placement since anhydrous ammonia was placed in the root zone while ammonium nitrate was placed on the surface of the soil where it stayed until sufficient precipitation fell to carry it into the root zone. One would not expect ammonia nitrogen to be any more or less efficient than a mixture of ammonia and nitrate nitrogen in the nutrition of a wheat plant.

The attempts to establish the proper time to apply nitrogen fertilizer for highest grain yield and protein content were somewhat fruitless; however, the results indicate that if anhydrous ammonia is to be used as the nitrogen carrier, it probably should be applied before planting to insure that there will be no loss in stand due to cultivation by the ammonia distributor. The extent of injury to stand by cultivation apparently depends on the moisture content of the soil, the firmness of rootbed, the stage of development of the plants, and the lapse of time from application until precipitation is received. None of these can be predicted at planting time so the safest approach is to apply anhydrous ammonia previous to planting.

Eck, H. V., and Stewart, B. A. WHEAT FERTILIZATION STUDIES IN WESTERN OKLAHOMA, 1955-1956. Okla. Agr. Expt. Sta. Mimeo. Cir. M-287. June, 1957.

This publication reports 1955-56 results of wheat fertility experiments conducted in Oklahoma. Results suggest that:

(1) Phosphorus is the first limiting chemical element in wheat growth on many soils in western Oklahoma. Maximum response from nitrogen fertilizer can be expected only after phosphorus needs are fulfilled. Even when phosphorus does not affect grain yields, it stimulates early growth and tillering. This is important from standpoints of reducing the danger of wind erosion, establishing stands, and providing winter pasture.

(2) Nitrogen fertilizer, when applied on a soil which contains adequate phosphate, will not decrease wheat yields even at high rates and under extreme drouth conditions.

(3) It may be advisable to delay nitrogen fertilization of wheat until late winter or early spring applications of nitrogen; in two seasons, there were relatively small yield advantages for spring over fall application; and in one season, there was a small advantage for fall over spring application of nitrogen. There has not been enough difference between fall and spring application of nitrogen to conclude that one is better than the other; however, spring application has the advantage of allowing the farmer to assess his crop prospects in the early spring before buying nitrogen fertilizer. This is especially important in an area where yields, as well as niyrogen response, are often controlled by moisture.

Ellis, B. G., Knauss, C. J., and Smith, F. W. NUTRIENT CONTENT OF CORN AS RELATED TO FERTILIZER APPLICATION AND SOIL FERTILITY. Agron. Jour. 48: 455-459. 1956.

Foliar analyses of corn leaves were made in conjunction with Kansas fertilizer experiments. A close relationship was found between content of exchangeable K in soil and leaf content of K. Definite establishment of minimum P content was not possible. Minimum N content for maximum yield varied with time of sampling, ranging from as much as 3.0 percent when corn was 3 feet high to only 1.9 percent at early ear stage. Addition of K to soils low in exchangeable K caused decreases in Mg content of leaves. Calcium content did not change markedly as a result of fertilizer application.

Farm Economics Res. Div. and Soil and Water Cons. Res. Div. FERTILIZER USED ON CROPS AND PASTURE IN THE UNITED STATES--1954 ESTIMATES. Stat. Bull. No. 216. Agr. Res. Serv., U. S. Dept. Agr., Aug. 1957.

This report consists primarily of State and regional estimates of use of fertilizer in 1954. The estimates are based on census data, evaluated by State committees, and expressed in terms of plant nutrients used on individual crops. In regional tables, similar estimates developed in 1947 and in 1950 are presented along with the estimates for 1954.

Fiskell, J. G. A., Thompson, L. G., Winsor, H., Jr., and Yuan, T. L. RELATIVE AVAILABILITY TO CORN OF NUTRIENT ELEMENTS AS AFFECTED BY MINOR ELEMENT SOURCES APPLIED TO EVERGLADES PEAT AND NORFOLK LOAMY FINE SAND. Agron. Jour. 49: 300-306. 1957.

The relative availability of Ca, Mg, K, P, Mn, Fe, Cu, Zn, Mo, and B to corn was compared between two soils by ratios of the corn ear leaf composition and by ratios found for the extractable soil nutrients. The effect of added minor element sources on the ear leaf composition was studied in the field. Nutrient changes were statistically evaluated. Significant B-Ca, B-Mg, B-Mo, and Zn-Mn relationships were found with the intensity dependent on the source. Minor element nutrients in the leaves were increased by adding soluble and moderately soluble sources when the available supply in the soil was low.

Fox, E. J., and Jackson, W. A. FERTILIZER TECHNOLOGY--SURFACTANTS IN FERTILIZERS. Agr. and Food Chem. 5: 578-586. 1957.

Surface active agent adsorbed on the equipment used in measuring the surface tension of aqueous surfactant solutions was found to be a source of error in attempting to determine the extent of surfactant adsorption on the surface of suspended phosphate rock particles. The equipment used to measure surface tension of solutions by the drop-weight method was modified to eliminate contact of the solution with a small-bore glass tube and a new procedure based on the change in bubble volume with surface tension was developed. Anionic surfactants were more readily adsorbed on acidic surfaces, while cationic surfactants were more readily adsorbed on basic materials. Acidic surfaces were made hydrophilic by the anionic surfactants and hydrophobic by cationic surfactants. The results were reversed in the case of basic materials.

Garman, P., and Mathis, W. T. STUDIES OF MINERAL BALANCE AS RELATED TO OCCURRENCE OF BALDWIN SPOT IN CONNECTICUT. Conn. Agr. Expt. Sta. Bull. 601. Oct. 1956.

From studies so far it is believed that unbalanced mineral ratios have a profound effect on stippin or Baldwin spot in Connecticut. It would appear that the critical element is calcium and the unbalanced condition lies between calcium and magnesium; or calcium and magnesium plus potassium. There is also a definite connection between the amount of spot and the leaf/fruit calcium ratio.

Efforts to cure the trouble have been partly successful through application of calcium salts both as sprays, and injected into the soil. Much more needs to be done especially with trees of unusual susceptibility. The influence of excess nitrogen can easily prevent a favorable balance through promotion of increased potassium and magnesium in the fruit.

Observations in general confirm those made earlier by others, namely: low spot with heavy yields, high spot with heavy nitrogen fertilization and heavy pruning.

Gausman, H. W., Cunningham, C. E., and Struchtemeyer, R. A. EFFECTS OF CHLORIDE AND SULFATE ON P^{32} UPTAKE BY POTATOES. Agron. Jour. 50: 90-91. 1958.

Chlorides and sulfates had a differential effect on the uptake of P^{32} by potatoes. Chlorides had a positive effect and sulfates a negative effect.

Gerwig, J. L., and Ahlgren, G. H. THE EFFECT OF DIFFERENT FERTILITY LEVELS ON YIELD, PERSISTENCE, AND CHEMICAL COMPOSITION OF ALFALFA. Agron. Jour. 50: 291-294. 1958.

Potash was the most important factor in maintaining high yields and persistence of an alfalfa stand. The "critical percentage" for potassium content varied from season to season and probably lies somewhere between 1.42 and 1.84%. Nitrogen fertilization tended to decrease yields and stands whereas phosphorus had no significant beneficial effect.

Gross, H. D., Wilsie, C. P., and Pesek, J. SOME RESPONSES OF ALFALFA VARIETIES TO FERTILIZATION AND CUTTING TREATMENTS. Agron. Jour. 50: 161-164. 1958.

During a 2-year period the following significant alfalfa yield responses were noted: variety X P, variety X cutting treatment and variety X cutting treatment X P. The third year, when plots were harvested alike, significant interactions were: variety X P and previous cutting treatment X K. Several varieties displayed flexibility in response to management practices. As measured in the third year, Buffalo and Vernal were the highest yielding varieties over all treatments. Stand differences, though statistically significant, were small and were not reflected in yield.

Hagen, C. E., Leggett, J. E., and Jackson, P. C. THE SITES OF ORTHOPHOSPHATE UPTAKE BY BARLEY ROOTS. Proc. of the Natl. Acad. Sci., Vol. 43, No. 6, pp. 496-506. June 1957.

Orthophosphate uptake by barley roots is coupled to sites identical with those for oxidative phosphorylation during electron transport in mammalian mitochondria.

Hanway, J. J., and Englehorn, A. J. NITRATE ACCUMULATION IN SOME IOWA CROP PLANTS. Agron. Jour. 50: 331-334. 1958.

Nitrate accumulation occurred in stalks or stems of corn, sorghum, and soybean plants. Legumes in the rotation or applications of manure or nitrogen fertilizer increased the nitrate content of the plants. The amount of nitrate in plants depended upon the stage of maturity, the degree of drouth injury, and the availability of nitrogen in the soil. Nitrate content was reduced but not destroyed by ensiling corn plants.

Hobbs, J. A., and Brown, P. L. NITROGEN CHANGES IN CULTIVATED DRYLAND SOIL. Agron. Jour. 49: 257-260. 1957.

Nitrogen losses from cultivated soils were most rapid immediately after breaking the native sod. Losses gradually decreased with continued cultivation in experiments from 1916 to 1946. Row crop production caused the largest losses of nitrogen. Small grain production caused the smallest losses. Under small grain, nitrogen losses had ceased by 1938. Elsewhere losses continued through 1946. Straw and manure applications reduced nitrogen losses. Earlier and more intensive tillage caused greater losses of soil nitrogen than later and less intensive cultivation.

Hood, J. T., Brady, N. C., and Lathwell, D. J. THE RELATIONSHIP OF WATER SOLUBLE AND EXCHANGEABLE POTASSIUM TO YIELD AND POTASSIUM UPTAKE BY LADINO CLOVER. Soil Sci. Soc. Amer. Proc. 20: 228-231. 1956.

An attempt was made to evaluate in a relative way the K in the soil solution as a measure of the immediately available potassium in the soil. When the K content of Ladino clover was below the critical level, the water soluble potassium, a measure of the K in the soil solution, was better correlated with yield than was exchangeable K. The water soluble potassium also gave a better correlation with the potassium absorbed by plants in a short period of time. A percolation procedure which consisted of leaching a soil with a large volume of a low electrolyte extractant was a better measure of the K supplying power of a soil than the initial exchangeable level of potassium.

Hunter, A. S., Gerard, C. J., Waddoups, H. M., Hall, W. E., Cushman, H. E., and Alban, L. A. THE EFFECT OF NITROGEN FERTILIZERS ON THE RELATIONSHIP BETWEEN INCREASES IN YIELDS AND PROTEIN CONTENT OF PASTRY-TYPE WHEATS. Agron. Jour. 50: 311-314. 1958.

Protein content was not raised to objectionably high values until more nitrogen was applied than that needed to produce "maximum yield." When applied nitrogen increased the yields significantly, they increased at a greater rate than protein content; for greater applications, protein content increased more rapidly than yield.

Jenne, E. A., Rhoades, H. F., Yien, C. H., and Howe, O. W. CHANGE IN NUTRIENT ELEMENT ACCUMULATION BY CORN WITH DEPLETION OF SOIL MOISTURE. Agron. Jour. 50: 71-74. 1958.

Phosphorus, dry matter, nitrogen, magnesium, potassium and calcium accumulation by the mature corn plant grown under conditions of decreasing soil moisture supply were 40, 44, 50, 65, 71 and 93%, respectively, of the values obtained for the mature corn plant produced with adequate moisture throughout the growing season.

Kamprath, E. J., Nelson, W. L., and Fitts, J. W. SULFUR REMOVED FROM SOILS BY FIELD CROPS. Agron. Jour. 49: 289-293. 1957.

More organic sulfur than inorganic sulfate was contained in the surface horizons of a Durham and Marlboro soil. In the lower horizons there was an accumulation of sulfate in both soils. On the Durham soil sulfur deficiencies were exhibited by cotton and tobacco early in the growing season. Only cotton gave a response to additions of gypsum. Cotton and soybeans removed considerably more sulfur than tobacco or corn. Availability of soil sulfur was evaluated by use of yield of sulfur curves.

Ketcheson, J. W. SOME EFFECTS OF SOIL TEMPERATURE ON PHOSPHORUS REQUIREMENTS OF YOUNG CORN PLANTS IN THE GREENHOUSE. Canad. Jour. Agr. Sci. 37: 41-47. 1957.

Germinated corn seedlings were planted in Burford loam soil in 1-gal. glazed pots and allowed to grow for 8 weeks in the greenhouse. Two levels of phosphorus, 0 and 20 p. p. m. P_2O_5, were used, along with a uniform treatment of nitrogen and potassium fertilizer. Carrier-free phosphorus-32 was placed in the bottom of the pot as compared with mixing throughout to indicate regions of root activity. One set of pots, consisting of four replications per treatment, was placed in a water bath averaging approximately 13° C. A corresponding set was placed on the greenhouse bench where temperature averaged approximately 20° C. Air temperature was the same for both sets.

Although the soil used for this study tested high in acid-soluble phosphorus and thereby suggested a low fertilizer phosphorus requirement, the use of phosphorus fertilizer significantly increased both the yield and phosphorus uptake of corn plants. Moreover, the relative increase for fertilizer was much greater under low temperature than under high temperature conditions. This was due to an actual reduction in phosphorus percentage in fertilized plants grown at the higher temperature while the reverse was true at the lower temperature level.

Root activity, particularly in the bottom portion of the pots, was reduced by low temperature, but phosphorus fertilizer partially overcame this effect. The consequence of these effects on growth of corn in the field, and on soil test correlation work, is mentioned.

Koehler, F. E., Moore, A. W., Allmaras, R. R., and Olson, R. A. INFLUENCE OF PAST SOIL TREATMENT ON YIELD, COMPOSITION, AND FERTILIZER PHOSPHORUS UTILIZATION BY ALFALFA. Soil Sci. Soc. Amer. Proc. 21: 201-205. 1957.

Phosphorus fertilizer was used at five rates on established stands of alfalfa on irrigated Tripp very fine sandy loam in western Nebraska. One rate of phosphorus fertilizer was tagged with P^{32}. Two 6-year rotations which included 3 years of alfalfa were used, one of which had received 12 tons of barnyard manure per acre per rotation cycle since 1912. Total phosphorus, nitrogen, and cation concentrations; fertilizer phosphorus concentration for the tagged treatment; and yields of alfalfa were measured for 2 years. Residual effects of first-year fertilizer applications were measured through the use of second applications of tagged phosphorus fertilizer.

All rates of phosphorus fertilizer increased the yield of alfalfa on the non-manured rotation while only the 160-pound P_2O_5 per acre rate caused a significant increase in yield on the manured rotation. The long-time use of manure increased the yield and phosphorus concentration of alfalfa. Phosphorus concentration in the alfalfa increased with increasing rates of phosphorus fertilization and decreased with plant maturity.

The long-time use of manure and the prior use of phosphorus fertilizer decreased the relative uptake of applied fertilizer phosphorus. Application of phosphorus fertilizer had little effect on concentration of either nitrogen or cations in alfalfa.

Lawton, K., and Tesar, M. B. YIELD, POTASSIUM CONTENT AND ROOT DISTRIBUTION OF ALFALFA AND BROME GRASS GROWN UNDER THREE LEVELS OF APPLIED POTASH IN THE GREENHOUSE. Agron. Jour. 50: 148-151. 1958.

In greenhouse trials, significant increases in yield and K absorption of alfalfa and bromegrass were obtained as applied K increased. Yield response to fertilizer K was less marked with soil containing more available soil K. Total production of bromegrass was half that of alfalfa, but the quantities of K removal were about equal. The change in several extractable fractions of soil K was directly related to the root distribution pattern of the forage.

MacLean, K. S., and Langille, W. M. MAJOR AND MINOR ELEMENT STATUS OF HEALTHY AND UNHEALTHY ALFALFA. Canad. Jour. Agr. Sci. 38: 241-245. 1958.

A study was made of the major and minor element status of healthy and unhealthy alfalfa. Elements determined were calcium, magnesium, potassium phosphorus, molybdenum, manganese, zinc and boron. Unhealthy alfalfa was found to be deficient in potassium and/or boron, the critical levels being 1 percent and 20 parts per million respectively.

The levels of other major and minor elements were similar in both healthy and unhealthy plants. Available soil boron was apparently positively correlated with plant tissue boron.

Martin, J. P., and Ervin, J. O. EFFECT OF DEGREE OF BASE SATURATION ON TOLERANCE OF AVOCADO SEEDLINGS TO EXCHANGEABLE Na AND K IN THE SOIL. Soil Sci. 83: 265-271. 1957.

A study was made of the influence of various exchangeable Na and K percentages on the growth and chemical composition of Mexicala avocado seedlings in acid soil, in base-saturated soil, and in soil containing 2 percent excess $CaCO_3$. Seedling growth and chemical composition were found to be largely dependent on the available supply of Na or K in the soil, and Ca supply or exchangeable H, over the range studies, was found to exert only minor effects. High exchangeable K or Na reduced Ca absorption more in acid soils than in base-saturated or excess-lime soil, but the reduction was not sufficient to influence growth. Increasing Na or K depressed leaf Ca more than root Ca. Leaf K appeared to be slightly increased by excess $CaCO_3$.

McAuliffe, C., Chamblee, D. S., Uribe-Arango, H., and Woodhouse, W. W., Jr. INFLUENCE OF INORGANIC NITROGEN ON NITROGEN FIXATION BY LEGUMES AS REVEALED BY N^{15}. Agron. Jour. 50: 334-337. 1958.

N^{15}-labeled fertilizer was used to determine the ratio of absorption of fixed vs. applied nitrogen by two legumes. Seedlings of both Ladino clover and alfalfa as well as established Ladino clover plants absorbed applied N fertilizer. Nitrogen fixation was reduced by nitrogen application, with the degree of reduction being definitely related to the amount of nitrogen applied.

McCants, C. B., and Black, C. A. A BIOLOGICAL SLOPE-RATIO METHOD FOR EVALUATING NUTRIENT AVAILABILITY IN SOILS. Soil Sci. Soc. Amer. Proc. 21: 296-301. 1957.

The slope-ratio method employed in biological assay was investigated as a means of evaluating the relative availability of a nutrient in different soils. This type of assay is used when the biological response increases linearly with the dose of the active ingredient. Under certain conditions the relative concentration of the active ingredient in two or more sources tested is equal to the ratio of the slopes of the lines representing the responses. To obtain linear responses, conditions of strong nutrient deficiency were imposed by growing the test plants in sand cultures to which increasing quantities of soil were added. Nutrients other than the one being evaluated were supplied in ample amount. In the experiment with nitrogen the results of three different types of experimental tests indicated that the ratio of the slopes of the lines representing the response functions provided a satisfactory estimate of the ratio of the availabilities. In an experiment the phosphorus, the tests indicated that for the various soils in general the ratio of the slopes was not a valid estimate of the relative phosphorus availabilities. In two instances in which there was no evidence that the slope ratios did not indicate the relative availabilities, the ratios of the availability of fertilizer phosphorus in the presence of soil to that in the absence of soil were found to be 0.2 and 0.5. These results demonstrate the invalidity of methods in which inferences about availabilities of soil phosphorus are based on the assumption that fertilizer phosphorus has the same availability in all soils.

McLean, E. O. PLANT GROWTH AND UPTAKE OF NUTRIENTS AS INFLUENCED BY LEVELS OF NITROGEN. Soil Sci. Soc. Amer. Proc. 21: 219-222. 1957.

The growth and uptake of various nutrients by plants grown in nutrients by plants grown in nutrient cultures are reported. The correlations between root cation-exchange capacities and their nitrogen compositions for these crops were reported previously.

Plants grown under variable nitrogen levels produced increased top growth with higher nitrogen level. However, root growth generally did not increase in proportion to increased top growth with higher nitrogen level, and in some cases root growth was actually decreased. This necessarily meant increased top/root ratio with increased nitrogen level.

There was no systematic relationship between root cation-exchange capacity (or percent nitrogen) with the composition of Ca, Mg, P, K, and Na when various crops were grown in 1/5 Hoagland solution. This may not be unexpected in specific media devoid of competing colloids where Donnan effects are at a minimum.

With individual crop species grown in cultures of variable nitrogen levels, plants took up relatively more Ca and Mg with higher nitrogen level. The contents P, K, and Na were generally decreased with greater nitrogen content of the medium. This suggests that increased root cation exchange and its consequent Donnan effects had a regulating influence upon the uptake of the nutrients by the individual crops. Other factors affecting nutrient uptake are also discussed.

Mikkelsen, D. S., and Finfrock, D. C. AVAILABILITY OF AMMONIACAL NITROGEN TO LOWLAND RICE AS INFLUENCED BY FERTILIZER PLACEMENT. Agron. Jour. 49: 296-300. 1957.

Subsurface (drilled) placement of ammonium nitrogen produced better growth and yields of rice than similar nitrogen applied on the soil surface (broadcast). Nitrogen content of rice plants and percentage recovery of the applied nitrogen also increased. Ammonium nitrogen drilled 2 to 4 inches into the soil, where reducing conditions developed 3 to 5 days after flooding, remained in the soil and was available to rice. Surface nitrogen, applied by broadcast methods, did not promote the best growth of rice. Losses of surface applied nitrogen apparently occurred through processes of nitrification and subsequently, denitrification.

Miller, E. V., Army, T. J., and Krackenberger, H. F. ASCORBIC ACID, CAROTENE, RIBOFLAVIN, AND THIAMINE CONTENTS OF TURNIP GREENS IN RELATION TO NITROGEN FERTILIZATION. Soil Sci. Soc. Amer. Proc. 20: 379-382. 1956.

Turnip plants were grown on 3 soils assembled in outdoor frames, using 3 levels of nitrogen fertilization, and comparing 2 nitrogen carriers. Relationships between nitrogen status and the contents of ascorbic acid, carotene, riboflavin, and thiamine were investigated. A strong response in yield was obtained from the application of nitrogen fertilizers.

For ascorbic acid the prevailing weather just prior to sampling was more closely related to the vitamin content than was nitrogen fertilization of nitrogen content. Treatments which produced the greatest amount of interplant shading were slightly inferior in ascorbic acid content.

Carotene, riboflavin, and thiamine content in leaf blades were highly correlated with nitrogen content. Carotene content was significantly higher with ammonium nitrate fertilizer than with sodium nitrate. Of the four vitamins tested, riboflavin showed the greatest decline in concentration with maturity.

In the treatments receiving repeated nitrogen sidedressings, thiamine content tended to remain high throughout the cropping period at about the same levels occurring in young plants.

Miller, M. H., and Ohlrogge, A. J. PRINCIPLES OF NUTRIENT UPTAKE FROM FERTILIZER BANDS. 1. EFFECT OF PLACEMENT OF NITROGEN FERTILIZER ON THE UPTAKE OF BAND-PLACED PHOSPHORUS AT DIFFERENT SOIL PHOSPHORUS LEVELS. Agron. Jour. 50: 95-97. 1958.

Placement of nitrogen fertilizer caused a relative increase in the feeding power of the root system on the band-placed phosphorus. Nitrogen had a greater influence when mixed with the phosphorus than when placed in a band 3 to 4 inches from the phosphorus band. The influence was nearly independent of the soil phosphate level when the nitrogen was mixed with the band phosphorus, but was not independent of the soil phosphate level when the nitrogen was separated from the phosphorus band.

Moschler, W. W., Krebs, R. D., and Obenshain, S. S. AVAILABILITY OF RESIDUAL PHOSPHORUS FROM LONG-TIME ROCK PHOSPHATE AND SUPERPHOSPHATE APPLICATIONS TO GROSECLOSE SILT LOAM. Soil Sci. Soc. Amer. Proc. 21: 293-295. 1957.

The availability of residual phosphorus from long-time superphosphate applications to Groseclose silt loam exceeded that of rock phosphate. Based on A values, residual phosphorus from superphosphate was approximately four times as available as that from rock phosphate.

Data on total, Truog, and $NaHCO_3$-soluble phosphorus showed that: (a) more of the superphosphate had reacted with the soil than had rock phosphate; more of the phosphorus applied as superphosphate had accumulated in the silt and clay factions of the soil and, based on solubility in $NaHCO_3$, was relatively available; and more of the phosphorus applied as rock phosphate had accumulated in the sand fraction of the soil and was relatively unavailable, as judged by solubility in $NaHCO_3$.

Apparently, some of the rock phosphate had not reacted with the soil and was still in its original molecular combination. X-ray analysis revealed the presence of apatite or a mineral similar to apatite in the sand fraction of soil that had received rock phosphate. The mineral, which gave pronounced reflections at the same values obtained from rock phosphate fertilizer, was not found in soil receiving superphosphate.

Approximately three-quarters of the phosphorus applied over a 40-year period from either source was present in the soil as residual phosphorus. This quantity nearly doubled the total phosphorus content of the soil. Crop yields on plots receiving the two fertilizers have been equal except for the first few years when superphosphate produced higher yields.

Murphy, H. F., and Lynd, J. Q. EFFECTS OF VARIOUS FERTILITY TREATMENTS ON ALFALFA PRODUCTION IN SOUTHEAST OKALHOMA. Soil Sci. Soc. Amer. Proc. 20: 385-387. 1956.

On limed Waynesboro very fine sandy loam at the Heavener Soil and Pasture Station in southeast Oklahoma, alfalfa gave highly significant increases in hay yield with additions of 32, 64 and 96 lbs. P_2O_5 per acre applied as 0-20-0. These phosphorus treatments combined with 72 lbs. K_2O as 0-0-60 gave larger increases over respective P_2O_5 treatments alone. The addition of 40 lbs. borax to the 0-64-72 treatment resulted in the highest yields in the experiment, averaging slightly less than 4 tons per acre annually for the 3-year period 1951, 1952, and 1953. This was more than double the check plot yields. Yields were lowered 569 lbs. hay per acre with addition of 480 lbs. $MgSO_4$ to the P_2KB treatment. Five tons of manure gave lower yields than the low phosphate treatment; the manure reinforced with 64 lbs. P_2O_5 yielded slightly less than the 96 lbs. P_2O_5 treatment. The range in total boron content of alfalfa was 15 to 70 ppm. Water soluble soil boron from the experimental plots ranged from 0.02 ppm. for untreated borax plots to 0.31 ppm. for plots receiving borax. Total boron in alfalfa was related to water soluble boron extracted from corresponding soil samples giving a correlation coefficient of 0.551.

Neller, J. R. EFFECT OF SULFUR AND GYPSUM ADDITIONS ON AVAILABILITY OF ROCK PHOSPHATE PHOSPHORUS IN LEON FINE SAND. Soil Sci. 82: 129-134. 1956.

Oats and Hubam clover were grown together in Leon fine sand in 2-gallon glazed jars. This soil, which is low in native phosphorus, received a uniform application of ground rock phosphate plus various amounts of sulfur. It had been heavily limed and ranged from pH 7.3 for unsulfured to pH 4.8 where the greatest amount of sulfur had been added. At pH 6.5 sufficient phosphorus became available for satisfactory growth of oats and clover (vegetative stage). At pH 5 growth of clover was seriously retarded and that of oats moderately so.

When the next year radioactive superphosphate was added to all treatments, its use with oats showed the phosphorus of the residual rock phosphate to be 13 percent more available in sulfured than in unsulfured soil.

Two plantings of oats and one of clover removed an equivalent of 77.3 percent of the phosphorus of the rock phosphate in the sulfured soil. An explanation is given for this high recovery in Leon fine sand, typical of the soils of the flatwoods where an extensive acreage of fertilized planted pastures has been established.

Nelson, W. W., and MacGregor, J. M. THE EFFECT OF TIME AND RATE OF FERTILIZER APPLICATION ON THE YIELD, COMPOSITION, AND LONGEVITY OF ALFALFA. Soil Sci. Soc. Amer. Proc. 21: 42-26. 1957.

An experiment was conducted on Port Byron silt loam (aeolian) at the Rosemount Experiment Station in eastern Minnesota to determine the effect of time and rate of fertilizer application on the yield, composition, and longevity of alfalfa. Six tons of lime per acre were applied late in 1949 and alfalfa was seeded early in the following spring. Commencing in 1951, three cuttings were made annually.

The total alfalfa yield without fertilizer for the 3 years (1951-53) was 9.69 tons per acre. Highly significant yield increases were obtained only where potash was included in the fertilizer. The highest 3-year total yield of 13.52 tons per acre was obtained by applying 1,000 pounds of 0-20-20 per acre in the spring before the alfalfa was seeded and later top-dressed with 200 pounds of 5-20-20 per acre for the second and the third crop years. When nitrogen was omitted from the top dressing, the 3-year yield was 13.44 tons.

Fall and spring fertilization was equally effective on the eight fertilizer treatments compared.

Crude protein, phosphorus, and potassium were generally highest in the second cutting of alfalfa and lowest in the first cutting. Crude protein content of the alfalfa varied from 19.1% to 24.8%, phosphorus from 0.20% to 0.39%, and potassium from 1.09% to 2.17%--the mineral content being affected by fertilizer treatment.

In the fourth year, the stand on most of the treatments was still very good.

Norland, M. A., Jackson, W. A., and Wieczorek, G. A. GREENHOUSE CROP RESPONSE TO WATER-INSOLUBLE PHOSPHATES WITH DIFFERENT SURFACE AREAS. Agr. and Food Chem. 5: 848-851. Nov. 1957.

Corn stover and alfalfa were grown in greenhouse cultures on slightly acid Chester soil to determine the effect of surface area of water-insoluble phosphorus in fertilizers upon yield and phosphorus uptake. Radioactive preparations of basic phosphate and of dicalcium phosphate with surface areas ranging from 0.7 to 22.8 square meters per gram were tested. Essentially the same yields of both corn and alfalfa were obtained with the dicalcium phosphates, although their surface areas differed by as much as 5 square meters per gram. Markedly lower yields resulted from using the basic phosphate despite the fact that its surface area was higher than that of any of the dicalcium phosphates. Thus, chemical composition appears to be more critical than surface area within the range studied.

Norland, M. A., Starostka, R. W., and Hill, W. L. FERTILIZER CHARACTERISTICS--INFLUENCE OF WATER-SOLUBLE PHOSPHORUS ON AGRONOMIC QUALITY OF FERTILIZER MIXTURES CONTAINING TWO PHOSPHORUS COMPOUNDS. Agr. and Food Chem. 5: 217-219. 1957.

Corn stover and hairy vetch were grown in greenhouse cultures on slightly acid Chester soil to determine the effect of variable proportions of water-soluble phosphorus in fertilizers upon yield and phosphorus uptake. Fertilizer mixtures containing varied percentages of water-soluble phosphorus, were applied to corn, and similar materials, as well as triple superphosphate and monammonium phosphate, applied applied to vetch. Increasing proportions of water-soluble phosphorus resulted in significantly greater yield and phosphorus uptake. In all but two of the test fertilizers, applied, corn stover and hairy vetch gave comparable results.

Odland, T. E., Bell, R. S., and Solomon, M. A FIELD COMPARISON OF EIGHT PHOSPHATE FERTILIZERS. Agron. Jour. 48(9): 409-412. Sept. 1956.

Differences in yields of corn from different phosphate sources were small, and in nearly all cases satisfactorily insignificant. Fused phosphate produced a significantly higher yield of hay than any other source. Differences in yield from other treatments were insignificant. Regular grade superphosphate, concentrated superphosphate, and dicalcium phosphate produced the highest yields of potatoes; rock phosphate produced only about 60 percent as high potato yield as these even at double the P_2O_5 rate. The other materials were intermediate. Tests at the close of the experiment showed the most extractable phosphorus in plots receiving rock phosphate, fused phosphate, or calcium metaphosphate.

Olson, R. A., Dreier, A. F., Lowrey, G. W., and Flowerday, A. D. AVAILABILITY OF PHOSPHATE CARRIERS TO SMALL GRAINS AND SUBSEQUENT CLOVER IN ROTATION TO: I. NATURE OF SOIL AND METHOD OF PLACEMENT. Agron. Jour. 48(3): 106-111. Mar. 1956.

Comparative effectiveness of phosphate carriers as shown in yield and uptake with small grains in Nebraska was found to be as follows: ammonium phospate $\geq$ concentrated superphosphate $\geq$ ordinary and ammoniated superphosphate, metaphosphate and high water solubility nitric phosphate $>$ Rhenanian, low water solubility nitric and fused tricalcium phosphates $>$ rock phosphate. Fertilizer nitrogen and effective placement were prime factors in promoting efficient utilization of phosphorus carriers. Phosphate availability to clover following oats was similar irrespective of carrier and placement method.

Olson, R. A., Dreier, A. F., Lowrey, G. W., and Flowerday, A. D. AVAILABILITY OF PHOSPHATE CARRIERS TO SMALL GRAINS AND SUBSEQUENT CLOVER IN RELATION TO: II. CONCURRENT SOIL AMENDMENTS. Agron. Jour. 48(3): 111-116. March. 1956.

Ammonium-N in contact with fertilizer P increased P uptake by wheat and oats with super- and metaphosphates. Potassium had no appreciable influence on P uptake. Liming acid soils reduced the effectiveness of most phosphate carriers to oats, but increased slightly their residual value for sweetclover. Sulfur addition to calcareous soils had little influence on carrier utilization by oats, but caused somewhat greater uptake of all carriers by subsequent clover.

Pope, A., and Cheney, H. B. THE POTASSIUM SUPPLYING POWER OF SEVERAL WESTERN OREGON SOILS. Soil Sci. Soc. Amer. Proc. 21: 75-79. 1957.

Soil samples from 20 sites representing 7 soil series were intensively cropped with Ladino clover in the greenhouse. The amounts of total and nonexchangeable potassium removed by the clover were determined. These values were then compared with the amounts of total and nonexchangeable potassium extracted by boiling 1N HNO_3 and the amount of exchangeable potassium present in the soils before and after cropping.

The soils varied widely in their potassium supplying power. The total amount of potassium extracted by HNO_3 was highly correlated with the amount of potassium removed from the soils by 10 successive cuttings of Ladino clover in the greenhouse ($r = 0.959$). The amount of potassium released from nonexchangeable forms by HNO_3 was highly correlated with the amount released during greehouse cropping ($r = 0.937$). The correlation coefficient for the total amount of potassium removed by the clover and the amount of exchangeable potassium in the soils before cropping was 0.852. The correlation between the amount of potassium released from nonexchangeable forms during cropping and the amount of exchangeable potassium before cropping was very low ($r = 0.174$).

Total potassium in the HNO_3 extract and potassium released from nonexchangeable forms by HNO_3 appeared to be better indexes than exchangeable potassium before cropping to potassium release and removal by intensive cropping with Ladino clover in the greenhouse.

Porter, K. B. GRAIN SORGHUM FERTILIZER TRIAL, AMARILLO EXPERIMENT STATION, 1955. Prog. Rpt. 1854, Tex. Agr. Expt. Sta., Mar. 2, 1956.

This report gives results obtained during the second year of a test initiated in 1954 on Pullman silty clay loam at the Amarillo Experiment Station.

The fertilizer treatments of the 1954 trial were repeated on the same plots in 1955. Similar results were obtained in the 2 years.

The response to nitrogen was greater in 1955 than in 1954. Plots receiving no nitrogen produced nearly twice as much in 1954 as in 1955. Nitrogen alone at 80 pounds per acre gave the most economical increase in yield, although the increase in yield between the 40 and 80-pound rates was less than the increase in yield between the 0 and 40-pound rates of nitrogen.

Power, J. F. FERTILIZING DRYLAND. Montana Farmer-Stockman. March 1, 1957.

Two years of extensive research on the use of commercial fertilizers for dryland spring wheat production in northeastern Montana offer some promising prospects for many areas.

The best results have come from the application of about 35 pounds per acre of treble superphosphate, applied with a fertilizer attachment on the drill. In certain cases, a mixed fertilizer has given better results. In very few instances has the application of nitrogen fertilizer alone been proven to be of value when applied to spring wheat grown on fallow.

Pumphrey, F. V., and Harris, Lionel. NITROGEN FERTILIZERS FOR CORN PRODUCTION ON AN IRRIGATED CHESTNUT SOIL. Agron. Jour. 48(5): 207-212. May 1956.

Studies of irrigated corn on old rotation plots on very fine sandy loam had the following general results: In year of H fertilizer application, increased yields were influenced by season and soil productivity as well as by time and rate of application. Time of application had little influence on yield on low productivity soil. Marked yield increases from residual N were also influenced by the above factors. Fertilizer N was more efficient during year of application when applied before plowing, at planting time, or side-dressed when corn was 6 to 12 inches high than when side-dressed when corn was 20 to 36 inches high. Yield increases from residual nitrogen increased with delay in time of application.

Purvis, E. R., and Peterson, N. H. METHODS OF SOIL AND PLANT ANALYSES FOR MOLYBDENUM. Soil Sci. 81: 223-228. 1956.

Methods for determining the molybdenum contents of soils and plants, and the available molybdenum content of soils, are discussed. Tested procedures are outlined for fusion of soil samples and the digestion of plant samples in preparation for analysis for total molybdenum content.

Reid, P. H., and York, E. T., Jr. EFFECT OF NUTRIENT DEFICIENCIES ON GROWTH AND FRUITING CHARACTERISTICS OF PEANUTS IN SAND CULTURES. Agron. Jour. 50: 63-67. 1958.

Nitrogen, calcium, magnesium, boron and sulfur deficiencies appeared rapidly after the respective elements were withheld from the culture solution. Phosphorus, potassium, manganese, iron, copper, zinc and molybdenum supplied early in the season were sufficient to complete the life cycle although growth and fruit formation were reduced.

Reid, P. H., and York, E. T., Jr. SOIL FERTILITY EFFECTS OF INTENSIVE GREENHOUSE CROPPING WITH PEANUTS. Agron. Jour. 49: 589-592. 1957.

Fertilization of peanuts with inorganic phosphorus plus potassium in amounts equal to that removed by the previous crop was more effective in maintaining peanut yield than was fertilization with the plant material. Phosphorus fertilization alone was of little value in maintaining production. After two crops, the soil potassium was reduced to a low level and a uniform rate of potassium supply was reached.

Reisenauer, H. M. MOLYBDENUM CONTENT OF ALFALFA IN RELATION TO DEFICIENCY SYMPTOMS AND RESPONSE TO MOLYBDENUM FERTILIZATION. Soil Sci. 81: 237-242. 1956.

Experiments were conducted on a molybdenum-responsive soil of northeastern Washington to relate the molybdenum content of alfalfa to severity of deficiency symptoms and to response to fertilization with this nutrient. The risual symptoms developed in field-grown alfalfa were an expression of nitrogen starvation and not a positive identification of molybdenum deficiency. Unnodulated alfalfa plants did not benefit from molybdenum fertilization. Where nodulation was satisfactory, increases in yield and nitrogen content of alfalfa hay were obtained from molybdenum fertilization. Maximum yields and protein-content of alfalfa plant tops were associated with leaf-molybdenum levels of 0.5 PPM or more.

Rendig, V. V. SULFUR AND NITROGEN COMPOSITION OF FERTILIZED AND UNFERTILIZED ALFALFA GROWN ON A SULFUR-DEFICIENT SOIL. Soil Sci. Soc. Amer. Proc. 20: 237-240. 1956.

A study was made of the effects of three levels of S fertilization (0, 200, 400 lbs. gypsum per acre) on several forms of S and N present in alfalfa grown on Delhi sand in the San Joaquin Valley of California. Previous studies with alfalfa on this soil have shown that the annual yield could be approximately doubled by an application of 200 lbs. gypsum per acre and that phosphate fertilizer had no significant effects on yield or P content.

Yield data were obtained at each of five successive cuttings of alfalfa. Forage samples were analyzed for total N, amide-N, free-amino-N, total S, SO_4-S, and methionine.

At all harvests, yields were increased by S; slightly higher yields were produced by 400 than by 200 lbs. gypsum per acre, the difference being significant for only the first two cuttings. For the first three harvests, the percentage of total S in the plant was approximately 3 times as great in alfalfa grown with 400 lbs. gypsum as in that grown without fertilization; the differences were progressively smaller at the fourth and fifth harvests. Most of the differences in S content could be accounted for as SO_4-S; however, a consistent difference in reduced-S was also noted, with maximum variation occurring at the third harvest, when the reduced-S contents were 0.11 and 0.17%, respectively, for alfalfa from plots receiving 0 and 400 lbs. gypsum per acre. This difference in reduced-S could not be accounted for as methionine; actually the percentage of the reduced-S present in this form was higher in the unfertilized alfalfa.

Rubins, E. J. MOLYBDENUM DEFICIENCIES IN THE UNITED STATES. Soil Sci. 81(3): 191-197. Mar. 1956.

Field deficiencies of molybdenum have been reported in 13 States and are suspected to occur in three others. The crops most commonly involved have been alfalfa, cauliflower, and citrus, but other affected crops include broccoli, tomato, cantaloupe, lettuce, sweet potato, sweet clover, and peas. Greenhouse experiments have shown deficiencies in four states that have not yet found deficiencies in the field. Evidence available suggests that the soils most likely to be deficient in the United States are the acid soils of the Atlantic and Gulf coasts. Some deficiencies have also occurred on well-limed or naturally neutral soils and on acid soils derived from calcareous parent materials. Excess molybdenum has been found in California, Oregon, and Florida soils.

Russell, G. C., Smith, A. D., and Pittman, U. J. THE EFFECT OF NITROGEN AND PHOSPHORUS FERTILIZERS ON THE YIELD AND PROTEIN CONTENT OF SPRING WHEAT GROWN ON STUBBLE FIELDS IN SOUTHERN ALBERTA. Canad. Jour. Agr. Sci. 38: 139-144. 1958.

Varying rates of nitrogen and phosphorus were applied to hard red spring wheat grown on stubble fields at three locations in southern Alberta in 1955 and 1956. Significant yield increases were obtained at the three locations in 1955 as a result of applications of nitrogen. At two of the three locations further increases in yield resulted from the addition of phosphorus. In 1956 significant yield increases were obtained at two of the three locations following applications, and at only one of these locations did the addition of phosphorus result in further significant increases in yield. At two of the three locations in both 1955 and 1956 high rates of nitrogen fertilizer caused significant increases in protein content over the unfertilized check. Phosphorus additions significantly reduced the effect of nitrogen on the protein content at one location in one year, but had no consistent effect in the other experiments. The experimental results indicate that, when moisture is adequate, more than 40 lb. of nitrogen per acre, and at least 80 lb. per acre in some cases, must be applied before increases in protein content of spring wheat can be expected.

Ray, H. E., MacGregor, J. M., and Schmidt, E. L. MOVEMENT OF AMMONIUM NITROGEN IN SOILS. Soil Sci. Soc. Amer. Proc. 21: 309-312. 1957.

The distribution of applied ammonium nitrogen in four southern Minnesota soils maintained at constant moisture tension and nitrogen concentration was determined in the laboratory. Ammonium nitrate enriched with N^{15} in the ammonium ion was used as a source of nitrogen. The soils varied in texture from loamy fine sand to loam, and in exchange capacity from 3.2 to 34.2 me. per 100 g.

Movement of ammonium nitrogen in Anoka loamy fine sand was predominantly downward and lateral. In contrast, movement of ammonium nitrogen in Nicollet loam was nearly symmetrical with slightly greater upward and lateral movement than downward movement. Retention of applied ammonium nitrogen in the zone of injection amounted to 2.0 me. per 100 g. of soil in Anoka loamy fine sand, and to 14.4 me. per 100 g. in Nicollet loam. Movement and retention of ammonium nitrogen were intermediate in the Fayette silt loam and the Barnes loam.

Seay, W. A., and Henson, L. VARIABILITY IN NUTRIENT UPTAKE AND YIELD OF CLONALLY PROPAGATED KENLAND RED CLOVER. Agron. Jour. 50: 165-168. 1958.

Dry matter yield, total uptake of soil and fertilizer P, utilization of fertilizer P mixed through the soil or topdressed and uptake of soil and fertilizer K varied much more among 30 clones of Kenland red clover than among replicates of clones. These same properties varied widely among 19 clones selected for longevity. It appears that plant yield or uptake of nutrients by clover or like plants can be measured more precisely by using all plants propagated from the same clone than by using seed which vary in genetic character.

Seay, W. A. SULFUR CONTAINED IN PRECIPITATION IN KENTUCKY. Agron. Jour. 49: 453-454. 1957.

Average annual precipitation at six locations ranged from 36 to 44 inches and yielded from 7 to 16 pounds of sulfur per acre. A highly significant correlation was found between inches of precipitation and pounds of sulfur contained. The state annual average of 12.6 pounds per acre of sulfur contained in the precipitation was much less than the 30 pounds found in a similar study in 1921-22.

Seay, W. A., and DeMumbrum, L. E. MINOR ELEMENT CONTENT OF EIGHT KENTUCKY SOILS AND LESPEDEZA. Agron. Jour. 50: 237-240. 1958.

Average ppm. of available minor elements in soils were 0.2 of Co, 1.7 of Zn, 0.8 of Cu, 25 of Mn and 0.8 of Ni; total ppm. in the Korean lespedeza: 0.6 of Co, 10.5 of Zn, 10 of Cu, 350 of Mn and 2.5 of Ni. Liming decreased availability of these five elements and available minor elements varied noticeably among soil types. Adding "major" nutrient fertilizers may in time decrease the available minor element content of soils because of removal in larger crop yields; available minor elements in soil may vary considerably with season.

Stauffer, R. S. EFFECTS OF LONG-TIME SOIL TREATMENTS ON THE ORGANIC CARBON CONTENT OF SOME ILLINOIS SOILS. Agron. Jour. 49: 598-600. 1957.

The organic carbon content of 8 soil types on 7 Illinois soil-experiment fields was relatively little affected by 40 years of different fertility treatments, although crop yields were increased markedly by the treatments. Three treatments, (1) manure, lime, and rock phosphate, (2) no lime or fertilizer, and (3) residues, lime, rock phosphate, and potash, were included in the study.

Stevenson, F. J. DISTRIBUTION OF THE FORMS OF NITROGEN IN SOME SOIL PROFILES. Soil Sci. Soc. Amer. Proc. 21: 283-287. 1957.

This paper presents a preliminary report of studies dealing with the chemistry of the nitrogen in the profiles of different soil types. Total, amino acid, and ammonia nitrogen determinations were made on acid hydrolysates of soil collected from 10 profiles representative of 8 great soil groups. The proportion of amino acid nitrogen to total nitrogen was found to decrease with depth in nearly all of the profiles examined, while the proportion of the nitrogen released as ammonia by acid hydrolysis was found to increase with depth. The magnitude of these changes was dependent on soil type. The results afford an explanation of the well-known phenomenon that the C/N ratio of most soils decreases with increasing depth in the profile. Some practical and theoretical aspects of the findings are considered.

Stout, P. R., and Johnson, C. M. MOLYBDENUM DEFICIENCY IN HORTICULTURAL AND FIELD CROPS. Soil Sci. 81(3): 183-191. Mar. 1956.

Because "whiptail" foliar symptoms (molybdenum-deficiency symptoms) in cauliflower and broccoli are so obvious and yield increases so dramatic when molybdenum is supplied or made available by liming, molybdenum nutrition of these plants has been studied in greater detail than that of most other plant species. Barley occupies a unique place among the Graminae in that no molybdenum response in soil has been reported.

White, W. C., Dumenil, L., and Pesek, J. EVALUATION OF RESIDUAL NITROGEN IN SOILS. Agron. Jour. 50: 255-259. 1958.

Effects of residual soil nitrogen on spring oats were estimated to be equivalent to quantities as large as 49% of the applications made to corn the preceding year. Nitrogen yield by oats served more satisfactorily than grain or dry matter yields for evaluating effects of residual nitrogen. Residual nitrogen estimated from linear regressions of nitrogen yield on nitrogen applied to oats appeared closely related to quantities of soil nitrate nitrogen, most of which was in the 6- to 21-inch soil layer.

Williams, D. E., and Vlamis, J. MANGANESE AND BORON TOXICITIES IN STANDARD CULTURE SOLUTIONS. Soil Sci. Soc. Amer. Proc. 21: 205-209. 1957.

Recommended concentrations of manganese and boron in Hoagland culture solutions have been found to be toxic to barley, slightly toxic to lettuce and non-toxic to tomato plants. Barley plants grown in standard Hoagland solutions developed dark brown spots on the older leaves. These spots varied from small spots to large blotchy areas.

A decrease in yield and an increase in spotting were found to be associated with an increase in the manganese and boron concentrations of the solutions.

A correlation was observed between the manganese content of the leaf and the appearance of manganese toxicity symptoms. Decreasing the manganese concentration, increasing the macro-salt concentration or adding sodium silicate to the culture solution repressed or prevented the appearance of manganese spots. Calcium, magnesium and potassium salts were found to be antagonistic to manganese, reducing the manganese content of the leaf tissue when supplementing the salts already present in the solutions. Silicon was found to repress manganese toxicity symptoms but had no effect upon the manganese content of the leaf tissue. Reducing the boron concentration or increasing the macro-salt concentration eliminated the boron type spotting while the addition of silicon resulted in only a slight decrease in the necrosis due to boron. Barley plants grown in winter tolerated much higher manganese and boron concentrations before showing toxicity symptoms than plants grown in the summer. Manganese and boron toxicity and manganese deficiency symptoms are compared in a photograph.

Structure Control

Allison, L. E. EFFECT OF SOIL CONDITIONING POLYMER ON THE CATION-EXCHANGE CAPACITY. Soil Sci. 83: 391-397. 1957.

The cation-exchange capacity of several western soils of varying characteristics was increased in all cases when treated in the laboratory with from 0.05 to 0.40 percent of either VAMA, HPAN, or IBMA soil conditioners. The increases in exchange capacity varied from approximately 2 percent for the lower to about 12 percent for the higher rates of treatment. In general, no one of the three conditioners apparently has any consistent advantage over the others in increasing the cation-exchange capacity of treated soil. Appreciable increases in cation-exchange capacity were also obtained on polymer-conditioned Pachappa loam from two field experiments in which the treated soil contained a high percentage of exchangeable sodium. In the first experiment (1951-56), a 0.1 percent VAMA treatment increased the cation-exchange capacity 8.3 percent on the average, and in the second experiment (1952-56), applications of 0.2 percent of either VAMA or HPAN gave increases in capacity which averaged about 12 percent. After 5 years for the first and 4 years for the second experiment, the initial increment of increase in cation-exchange capacity had reduced by 21 and 38 percent, respectively. An explanation is offered for the observed increase in cation-exchange capacity in polymer-conditioned soil. The need for thorough and intimate contact between soil and conditioner at time of application is emphasized if maximum physical and chemical changes are to be obtained.

McCalla, T. M., Haskins, F. A., and Frolik, E. F. INFLUENCE OF VARIOUS FACTORS ON AGGREGATION OF PEORIAN LOESS BY MICROORGANISMS. Soil Sci. 84: 155-161. 1957.

Thirty-three fungi and one actinomycete were isolated from Nebraska soils and tested for their effectiveness in aggregating Peoria loess. In addition, a number of other fungi and actinomycetes were tested for aggregating ability with straw and sucrose as energy sources. Three of the more effective cultures were selected and tested for aggregating ability under various levels of carbon source, moisture, temperature, and time. Large differences in aggregating ability were found among the different cultures.

In general, the aggregation affected with sucrose as a source of energy was considerably higher than that obtained with straw, and only a few cultures were found to promote appreciable aggregation with straw as the carbon source. Under favorable conditions of temperature, moisture, and energy source in the laboratory, the more effective cultures promoted a high degree of aggregation of Peorian loess in a relatively short time (3 to 7 days).

Smith, R. M., and Thompson, D. O. TEXAS EARTHWORMS ARE BIG, TOO! What's New in Crops & Soils, Vol. 6, No. 7. April-May 1954.

Single worms grow big, and their total effect looks like an important factor in Blackland farming.

If you live where rainfall is higher than the 30- to 40-inch belt of Texas, you might have thought that earthworms were of no importance this close to the border of the subhumid west. But when it rains in the Blackland and westward into the Grand Prairie, the earthworms are ready to work.

Five to eight tons of fresh worm casts per acre have been picked up from the soil surface after one good rain. And as much as 25 percent of the plow layer of soil in good condition has been separated out by hand as recognizable worm casts. This amount to half a million pounds per acre, and is what we call big workings in any part of the country.

Youker, R. E., and McGuinness, J. L. A SHORT METHOD OF OBTAINING MEAN WEIGHT-DIAMETER VALUES OF AGGREGATE ANALYSES OF SOILS. Soil Sci. 83: 291-294. 1957.

A quick and reliable method of calculating the mean weight-diameter statistic for aggregate analyses of soils is presented. No graphic work is necessary. The entire procedure can be worked on a desk calculator in a matter of seconds.

Drainage

Fukuda, H. UNDERDRAINAGE INTO DITCHES IN SOIL OVERLYING AN IMPERVIOUS SUBSTRATUM. Amer. Geophys. Union Trans. 38: 730-739. 1957.

Using conformal transformations, theoretical equations are derived for the quantity of water, in water-saturated soil, seeping per unit time, from a plane watertable into equally spaced ditches with vertical walls. An approximate theory is also given for ditches which do not have vertical walls. Several of the theoretical equations are tested experimentally and are found to be in agreement with the experimental results.

Lag, J., and Einevoll, O. PRELIMINARY STUDIES ON THE WATER PERMEABILITY OF RAW HUMUS IN PODZOL PROFILES IN THE WESTERN PART OF NORWAY. The State Soil Investigation, Agr. College of Norway. 1954.

Introductory field and laboratory experiments on the water permeability of raw humus in podzol profiles in the western part of Norway were carried out as a part of a series of investigations on the influence of soil-forming factors in Norway. Some types of raw humus are so slightly permeable that some of the precipitation is not able to percolate through the soil profile. Under such conditions an increase in the precipitation intensity will not cause increased percolation but rather give rise to greater quantities of runoff water.

Loehnberg, A. WATER SUPPLY AND DRAINAGE IN SEMI-ARID COUNTRIES. Amer. Geophys. Union Trans. 38: 501-510. 1957.

Drainage cannot be separated from water supply for land development in hill-plain border regions of semi-arid countries. In order to avoid economic and technical *cul de sacs*, resulting from the usual procedures of amelioration, drainage should be considered a residual engineering task, incidental to and following the use of water resources.

If it is desired to irrigate a maximum area of land, a priority of sequences must be fixed at an early stage for the measures taken to exploit successively the total inventory of surface and subsurface waters. A general scheme of priorities establishes the following precedences: (a) water supply before drainage and flood control, (b) use of subsurface before surface waters, (c) abstraction from foreland ground-water horizons before mountain ground water, (d) development of hill before valley springs, and (e) use and creation of underground storage before surface storage.

It is not possible to devise a rational drainage scheme and to plan the maximum exploitation of local water resources without operating wells on a year-round basis. If this premise is accepted, wells must be sited and installed so as to serve several purposes: (a) to extract the average annual replenishment and gradually most of the fossil reserve, (b) to drain marshy lands in the plain, (c) to accept recharge from winter-spring flows, floods, and foreland wells, and (d) to extract subsurface winter flow in the foreland and to recharge it into mountain wells (recycling).

Manson, P. W., and Blaisdell, F. W. ENERGY LOSSES AT DRAINTILE JUNCTIONS. Agr. Engin. 37(4): 249-252. Apr. 1956.

Laboratory equipment substitutes for actual field conditions as results indicate no significant advantage from a practical standpoint between a 45- and a 90-degree junction angle in agricultural tile drainage systems.

Irrigation

Bagley, J. M., and Criddle, W. D. EVALUATION OF SPRINKLER IRRIGATION SYSTEMS IN NORTHERN UTAH. Utah Agr. Expt. Sta. and U. S. Dept. Agr. Bul. 387. 1956.

Maximum benefit from a sprinkler irrigation system cannot be realized unless it is properly designed and operated. Development of a successfully designed system and its operation require a knowledge and understanding of the complex plant, soil, and water relations. These factors must be considered and the system then designed to meet the farmer's desires and work schedule. It should be the responsibility of the sprinkler system designer not only to install the equipment properly, but to train the farmer in its correct use.

This study clearly demonstrated that each farm presents a wide variety of problems which must be solved in various ways. The simple fact that every farm and farmer is different precludes the possibility of being able to go into a department store and purchase a "package sprinkler unit" that will meet the farmer's needs.

Bendelow, V. M. THE EFFECT OF IRRIGATION ON YIELD AND MALTING QUALITY OF BARLEY IN SOUTHERN ALBERTA. Canad. Jour. Agr. Sci. 38: 135-138. 1958.

Comparisons were made of the yield and malting quality of Montcalm barley grown on dryland and on irrigated plots in two different rotations at the Experimental Sub-station, Taber, Alberta. A supplementary study of the effect of fertilizer was introduced into the experiment. Irrigation significantly increased the yield of grain and improved malting quality, mainly by increasing extract. An increase in yield was also shown on fertilizer treated plots under irrigation, but the amount of increase depended on environmental factors associated with the crop rotation system. The effect of fertilizer on malting quality was insignificant.

Bliss, E. S., and Muckel, D. C. HOW MUCH IS ENOUGH? California Vector Views, Vol. 4, No. 8, August 1957.

Data are given which show how much water is sufficient for irrigation. The use of improved practices which give better water distribution and greater irrigation efficiency will provide for better salinity control and at the same time go a long way toward eliminating mosquito production on orrigated fields.

Bloodworth, M. E., Burleson, C. A., and Cowley, W. R. ROOT DISTRIBUTION OF SOME IRRIGATED CROPS USING UNDISRUPTED SOIL CORES. Agron. Jour. 50: 317-320. 1958.

In irrigated areas where a "plowsole" layer existed, a large percentage of plant roots were found to occupy the first foot of soil and especially the first 6 inches. The number and size distribution of roots per increment of soil depth gave a better comparison between different crops from the standpoint of soil physical properties than a comparison of root weights alone.

Day, A. D. YIELD AND QUALITY OF SPRING MALTING BARLEY VARIETIES GROWN AS WINTER ANNUALS UNDER IRRIGATION. Agron. Jour. 50: 68-71. 1958.

Of twenty spring barley varieties grown as winter annuals under irrigation the Coast group was higher yielding, but lower in malting quality than the Manchuria group. In general the Coast group was more resistant to lodging and shattering than the Manchuria group.

Gallatin, M. H. UTILIZATION OF BRACKISH WATER FOR IRRIGATION OF GREEN BEANS AND POTATOES. The Vegetable Growers News, Vol. 12, No. 1, July, 1957.

Potatoes: Results with brackish water irrigation show a noticeable reduction in yield with increasing salt concentration when irrigated at 0.5 atm. tension (the moist plots), but not when irrigated at 4.0 atm. (the dry plots).

The Irish potato, which is considered a medium salt-tolerant crop, apparently is affected by increasing concentrations of salt in irrigation water although the differences in this study were not large enough to establish statistical significance.

Greatest differences in yields were obtained from the frequency of application plots. Plots irrigated with brackish water at a soil moisture tension of 4.0 atm. produced more potatoes than plots irrigated at 0.5 atms. tension.

Leaf burn and breakdown were not apparent in the plots until just before harvest or two weeks after completing irrigation. The burn was more or less proportional to the salt concentration of water applied.

Green Beans: The data show increasing reduction in yield due to increasing salt concentration regardless of method, amount or frequency or irrigation. The yield was higher in those plots receiving overhead irrigation than in plots receiving surface irrigation. For the most part, the one-inch application was more satisfactory than the two-inch.

Irrigation with brackish water applied when the soil moisture tension reached 4.0 atm. (dry plots) produced significantly greater yields than plots irrigated at 0.5 atm. (moist plots).

It is possible to use brackish water for irrigation of beans, but yields will be reduced as salt concentrations and frequency of application increase.

Gardner, W. R., and Brooks, R. H. A DESCRIPTIVE THEORY OF LEACHING. Soil Sci. 83: 295-304. 1957.

Equations are derived to describe the leaching of soluble salts from soils. The flow process itself, rather than diffusion, is assumed to be responsible both for the diffuse boundary between the soil solution and the leaching water and for the subsequent removal of the bypassed salt.

The theory here presented is compared with experimental data obtained from laboratory soil columns and a field plot. Agreement between theory and experiment was found to be satisfactory.

Lauritzen, C. W. SEEPAGE CONTROL WITH PLASTIC FILM. Irrigation Engin. and Maintenance. May 1957.

Recent investigation of plastic film linings for irrigation canals and reservoirs have shown that they can be used successfully for some types of installations. Plastic films presently available have some disadvantages and better materials will most certainly be developed in the future. Pending the development of improved materials, however, the present films deserve serious consideration as a means of seepage control. The name film in itself implies thinness and indirectly weakness. This interpretation accurately describes the properties of the materials discussed.

Ross, P. E., and Swanson, N. P. LEVEL IRRIGATION. Jour. Soil and Water Conserv. 12: 209-214. 1957.

Level irrigation as developed in the Southwest during recent years has provided far farmers with a means of excellent control of irrigation water. This has resulted in improved application efficiency and more uniform applications of irrigation water. It has also reduced operation costs and thus increased the net income from the irrigated lands. It has made possible better land-management practices and contributed considerably to the permanency of irrigated agriculture in the areas where it is being used. This system of irrigation has a wide range of applicability and should be considered carefully by irrigation engineers who have the responsibility for designing irrigation systems.

Spooner, A. E., Caviness, C. E., and Spurgeon, W. I. INFLUENCE OF TIMING OF IRRIGATION ON YIELD, QUALITY AND FRUITING OF UPLAND COTTON. Agron. Jour. 50: 74-77. 1958.

Irrigation increased the yield of cotton approximately 1 bale per acre, but water applied before blooming had no beneficial effect. Maturity was delayed and the peak of fruiting was extended 2 weeks by irrigation. Shedding was significantly decreased and boll size was significantly increased. Lint quality was improved in most cases by proper moisture conditions.

Swanson, N. P., and Thaxton, E. L., Jr. REQUIREMENTS FOR GRAIN SORGHUM IRRIGATION ON THE HIGH PLAINS. Tex. Agr. Expt. Sta. Bul. 846. Jan. 1957.

Irrigation research was conducted with grain sorghum on the optimum use of underground water resources at the Amarillo and Lubbock Experiment Stations and on off-station plots during the past several years.

Highest returns in pounds of grain per inch of water were received when grain sorghum is supplied with adequate moisture from planting to the soft dough stage.

High-moisture levels are the most profitable; if the irrigation water supply becomes inadequate, the acreage to which water is applied should be reduced.

A grain sorghum crop can be produced with a preplanting irrigation alone in very dry years when dryland crops are complete failures.

Nitrogen fertilizers can be used to advantage with proper water management and will provide yields of 5,000 pounds or more of grain per acre.

Erosion Control

Biswell, H. H., and Schultz, A. M. SURFACE RUNOFF AND EROSION RELATED TO PRESCRIBED BURNING. Jour. Forestry 55: 372-374. 1957.

There was no indication of surface runoff and erosion in California following prescribed burning that could be related to the burning itself, even after abnormally heavy rains on fresh ashes. Partially decomposed duff and debris remaining after prescribed burning was effective in maintaining high infiltration and percolation capacity.

Chepil, W. S. DUST BOWL: CAUSES AND EFFECTS. Jour. Soil and Water Conserv. 12: 108-111. 1957.

Dust storms occur within periods of prolonged drought and extreme wind velocity, but they do not have to be as severe as they have been in the recent past.

With new techniques of maintaining soil cloddiness, vegetative cover, surface barriers and roughness, erosion can be controlled as when the soil was protected by native grasses. Today some soils are more erodible than they were when first brought out of sod, and some are less erodible. Some lands must be put back in grass, or they will be abandoned and remain a threat to better lands around them. The greatest need today is a determination and willingness to leave the land in as good or better condition than it was found.

Gard, L. E., Klingebiel, A. A., and Van Doren, C. A. THE EFFECT OF CROP RESIDUES ON SOIL AND WATER LOSSES FROM CORN AND WINTER WHEAT. Soil Sci. Soc. Amer. Proc. 20: 279-283. 1956.

Soil and water losses from plots planted to a corn, winter wheat, and lespedeza rotation were measured for 14 years. The plots, located on Grantsburg silt loam were 70 feet long and on slopes of 5% and 9%. During the period 1939-46, crop residues were removed or grazed from the plots. The average annual precipitation was 3 inches greater during the 1947-53 period than in the 1939-46 period. The maximum rainfall intensity (15-minute period) for the storms producing over 80% of the total soil loss was highly significantly greater during the 1947-53 period, when crop residues were returned, than in the 1939-46 period, when crop residues were removed.

Comparable individual storms that produced over 80% of the total soil loss were analyzed for each of the two periods. Soil loss "per inch of rain" from corn plots was over three times greater when residues were removed than when they were returned on both the 5% and 9% slopes. Soil loss "per inch of rain" from winter wheat plots on the 5% slope was 3.9 times greater, and on the 9% slope 2.4 times greater when the residues were removed than when they were returned.

Krimgold, D. B., and Shahori, Ami. DESIGN RAIN--AID IN EROSION CONTROL STUDIES. Agr. Engin. 38: 740-743. 1957.

Rather than wait for the "once-in-10-years" runoff and erosion, the authors selected and reproduced the required rain and conditions.

Miller, J. F., and Paulhus, J. L. H. RAINFALL-RUNOFF RELATION FOR SMALL BASINS. Amer. Geophys. Union Trans. 38: 216-218. 1957.

Procedures for computing storm runoff from rainfall for other than very small basins have been in use for many years. A rainfall-runoff relation for a basin of 4.1 sq. mi. is derived and is found to be applicable to other small basins.

Potter, W. D. UPPER AND LOWER FREQUENCY CURVES FOR PEAK RATES OF RUNOFF. Amer. Georphys. Union Trans. 39: 100-105. 1958.

Maximum annual peak rates of runoff plotted on extremal probability paper have many time been found to exhibit trends that may be defined by two straight lines designated as upper and lower frequency curves. Using a sample of 69 gaged watersheds with periods of record ranging from 26 to 48 years, a high degree of correlation is found to exist between the upper and lower frequency curves for 10- and 50-year recurrence intervals. Tests are made to show that these relations may be used in conjunction with periods of record as short as ten years to materially improve the precision of estimates of peaks on the upper frequency curve.

Evidence is presented that suggests that the dog leg in frequency curves is the result of sampling from two different populations of peak rates of runoff.

Wischmeier, W. H., and Smith, D. D. RAINFALL ENERGY AND ITS RELATIONSHIP TO SOIL LOSS. Amer. Geophys. Union Trans. 39: 285-291. 1958.

A relatively simple procedure is presented for computation of kinetic energy of a rainstorm from information on a recording-raingage chart. An equation is developed describing rainfall energy as a function of rainfall intensity. The effects of rainfall energy and its interaction with other variables are evaluated in multiple regression analyses based on data representing four soil types. Application of this information to separate the effects of rainfall from those of physical and management characteristics in plot data is discussed briefly.

Woodruff, N. P., Chepil, W. S., and Lynch, R. D. EMERGENCY CHISELING TO CONTROL WIND EROSION. Kans. Agr. Expt. Sta. Tech. Bull. 90. July 1957.

The problem of determining the correct procedures for the emergency-tillage operations on medium-textured soils is a complex one. In summary, however, the following conclusions seem pertinent:

(1) Spacing of chisels should depend on the particular area being worked. Close spacing (27 inches--Fig. 18B) is more effective in general. In cases of moderate erosion wider spacing (44 to 54 inches--Fig. 18A) may permit salvaging some of a growing wheat crop.

(2) Choice of a chisel point on medium-textured soils should depend upon soil compaction. In loose soils, a shovel (Fig. 18C) should be used. In compact soils a narrow chisel, preferably the heavy-duty type (Fig. 18B) should be used.

(3) Looser soils, if they should be chiseled at all, should be chiseled deeper (Fig. 18C) than the more compact soils (Fig. 18B). Chiseling should be done deep enough to bring clods to the surface. If it has to be so deep that it reduces speed below about 2 m. p. h., sufficient clods will not be brought up. Under such a condition chiseling is doomed from the beginning. Deep listing may be the only resort.

(4) Insofar as the immediate effect of the tillage operation is concerned, high speeds on compacted soils are recommended. More land can be covered at less expense with less discomfort to the operator.

(5) If the long-term effect is to be considered, emergency tillage should be accomplished at intermediate speeds of about 3.5 to 4 m. p. h. Clods thrown up and roughness and resistance to erosion will be nearly as great as for the high speeds.

Cropping Systems

Braun, G. WITHDRAWALS FROM THE SOIL BANK; PACIFIC NORTHWEST CROPS. Better Crops with Plant Food, Vol. 40, No. 81, pp. 13-16. 42-44. Oct. 1956.

The author lists the pounds per acre of N, P_2O_5, K_2O, S and MgO removed by various crops grown in the Pacific Northwest.

Flocker, W. J., Vomocil, J. A., Vittum, M. T., and Doneen, L. D. EFFECT OF ROTATION WITH GREEN MANURING AND IRRIGATION ON PHYSICAL CHARACTERISTICS OF HESPERIA SANDY LOAM. Agron. Jour. 50: 251-254.

Some physical characteristics of Hesperia sandy loam were studied after 8 years of 9 different rotation treatments. Data from 4 rotations of cultivated row crops only were compared with data from 4 rotations of cultivated row crops plus cover crops. Rotations which included cover crops, did not significantly increase organic matter content of this soil nor the infiltration rate, did not change bulk density, but did slightly increase degree of cloddiness.

Hamilton, J., Stanberry, C. O., and Wootton, W. M. COTTON GROWTH AND PRODUCTION AS AFFECTED BY MOISTURE, NITROGEN, AND PLANT SPACING ON THE YUMA MESA. Soil Sci. Soc. Amer. Proc. 20: 246-252. 1956.

Acala 44 cotton was grown near Yuma, Ariz. on irrigated Superstition loamy sand having a steep productivity gradient from one end of the field to the other. Effects of soil moisture, N rate, and plant spacing, each at 3 levels in a factorial experiment, were determined for vegetative growth, fruiting, N uptake, yields, and ginning and fiber characteristics.

Yields were increased substantially by N, and significantly, but less so by moisture and spacing. The spacing effect was limited to the second of 2 pickings. Considering the 4 direct factors which determine cotton yields (total flowers, percent boll-set, boll size, and percent lint) fertilizer affected 2 and spacing 4 of these factors. The precision of the experiment did not permit a decision as to how moisture increased yields since none of the 4 factors were affected significantly.

Cotton growth and production were unsatisfactory where substantial cuts were made in leveling the field before planting. The range of yields among individual plots varied almost 800% with a maximum of 2.51 bales and a mean of 1.28 bales of lint per acre. In spite of the large productivity gradient and resultant variations in growth and yield, relative response to a given treatment was remarkably resistent.

Pumphrey, F. V., and Koehler, F. E. FORAGE AND ROOT GROWTH OF FIVE SWEETCLOVER VARIETIES AND THEIR INFLUENCE ON TWO FOLLOWING CORN CROPS. Agron. Jour. 50: 323-326. 1958.

Spanish, Evergreen, and Madrid sweetclovers differed little in dry matter production and nitrogen content in first- and early second-year growth and exceeded common white only in first-year growth. Hubam produced more forage, but contained no more nitrogen per acre. The biennial varieties did not differ appreciably in quantity of roots per acre. Nearly 90% of the roots were in the top foot. Nitrogen content of the roots decreased with increasing depth.

Smith, R. M., Hervey, R. J., and Cook, E. D. TWO-YEAR CONSERVATION SYSTEMS. Soil and Water. June 1957.

Research through a number of years has shown that certain crop rotations can make an important contribution to cotton yields, even when all other known good practices are followed. Average seed cotton yields on fertile Houston Black clay and Austin clay soils are shown in Table 1. Site I covers an 8-year period, site II is for the past 4 years, and sites III, IV and V are for a 3-year period starting in 1948.

The influence of crop rotations depends on the kind of land as well as the season. This is well illustrated by 3 years of results on sites IV and V, where one set of plots was on gently sloping Houston Black clay and the other was on more sloping and eroded Austin clay. At all 5 sites mentioned there has been a response to the 2-year rotations compared to continuous cotton. Sites I and III gave highest yields when sweetclover was included with the oats. Cotton root rot was a major factor at site V. In general, the results suggest that other factors usually have been more limiting than nitrogen or other plant nutrients.

Winterlin, W. L., McCalla, T. M., and Luebs, R. E. STUBBLE-MULCH TILLAGE VERSUS PLOWING WITH NITROGEN FERTILIZATION WITH REGARD TO NUTRIENT UPTAKE BY CEREALS. Agron. Jour. 50: 241-243. 1958.

Stubble-mulch tillage compared to plowing, with and without nitrogen, on corn, oats and wheat during 2 years on 4 fields at Lincoln, Nebraska, produced plant tissue and grain of similar content of Ca, Mg, P and K. The N content of plant tissue produced by stubble-mulch tillage tended to be lower than that produced by plowing in most cases; yields also tended to be lower with the former. Nitrogen fertilizer largely overcame this effect.

Tillage and Cultural Practices

Daniel, H. A., Cox, M. B., Tucker, B. B., and Viets, F. G., Jr. DESIGN OF PLOTS CONFORMING TO THE LAND FOR EVALUATING MOISTURE CONSERVATION PRACTICES. Soil Sci. Soc. Amer. Proc. 21: 347-350. 1957.

A system of plots designed to conform to the land was in operation on the Wheatland Conservation Experiment Station, Cherokee, Oklahoma, from 1942 through 1951. The arrangement permitted the use of moderately sloping land for plot sizes approaching field conditions. The experiment was designed to compare the effectiveness of different seedbed preparations for the conservation of runoff water for plant growth. The tillage practices conducted on both terraced and unterraced land in a factorial arrangement of plots were plowing, listing, basin listing, and stubble mulch tillage. This report evaluates the experimental technique of such a system of plots and determines the variability experienced and differences assessable from measurements of runoff, soil moisture, and crop yields.

Runoff was measured with type H flumes and Friez FW-1 waterstage recorders. Amounts and intensities of rainfall were measured by Ferguson recording rain gages and checked by standard gages at 10 points located systematically on the station. Annual yields of winter wheat and soil moisture to a depth of 3 feet at planting and in the spring were measured.

The system for measuring runoff water has been satisfactory. For the 10 years of data, the variability in all quantities measured was high. Nevertheless, significant differences were obtained on a site typical of a large area where soils and slopes were highly variable. The amount of runoff water from the terraced and contour cultivated land was significantly less than that from plots cultivated with the slope. When the four methods of seedbed preparation were compared, stubble mulching significantly reduced the yield of wheat.

Hessenthaler, W. H. MACHINE LAYING OF POLYETHYLENE MULCH. Agr. Engin. 39: 235-236. 1958.

This mulch-laying equipment has been used successfully on a seven-acre field of sandy loam soil to lay 4-ft-wide film on 7-ft center at a rate of more than one acre per hours. The film was laid during windy weather, but no difficulties were experienced during or after the mulching operation. Tomatoes and melons were planted through this mulch and no dislocation or loosening of the film was reported during or following the operation.

Pendleton, J. W., and Dungan, G. H. EFFECT OF ROW DIRECTION ON SPRING OAT YIELDS. Agron. Jour. 50: 341-343. 1958.

Spring oats drilled in north-south direction yielded slightly more grain than those seeded in east-west direction. The advantage for north-south row direction increased as row spacing increased. Stand counts of interseeded clover varied with oat row spacings and this variation was affected by distance from the oat rows and also the direction of the oat rows. Soil moisture and light intensity data were collected in an attempt to explain this interesting ecological phenomenon.

Penfound, W. T., and Rice, E. L. EFFECTS OF FENCING AND PLOWING ON PLANT SUCCESSION IN A REVEGETATING FIELD. Jour. Range Management 10: 21-22. 1957.

This paper presents a comparison of the plant populations in a revegetating, abandoned field (control) and a replowed portion of the abandoned field over a five-year period (1950 through 1954). At the beginning of the period the abandoned field (control) was dominated by threeawn grass, Korean lespedeza, and Scribner's panic grass, but by 1954, the dominants were Scribner's panic grass, western ragweed, many-flowered aster, and fall witchgrass.

In the first spring after plowing, the plowed abandoned field was dominated by western ragweed, Korean lespedeza, false dandelion, and buffalo-fur, but at the end of the observation period the only important plants in the replowed plots were many flowered aster witchgrass.

Russell, E. W. THE EFFECTS OF VERY DEEP PLOUGHING AND OF SUBSOILING ON CROP YIELDS. Jour. Agr. Sci. 48(2): 129-144. 1956.

Plowing to a depth exceeding 12 inches or subsoiling to a depth of about 18 inches increased crop yields on about half the fields in which the experiment was made. Differences in soil properties were not recognizable between the 50 percent of fields that responded appreciably to deep tillage and the reminder whose yields were either unaffected or sometimes reduced by deep tillage. However, sands were normally less responsive to deep tillage than the heavier soils. Deep autumn plowing of clay soils gave a surface soil that dried out up to several weeks earlier in the spring, than land that was shallow ploughed. Subsoiling did not cause the surface soil to dry out in the same way. Effects of deep plowing and subsoiling on crop yields and weed control are also given.

Siddoway, F. H., McKay, H. C., and Klages, K. H. DRYLAND TILLAGE METHODS AND IMPLEMENTS. Idaho Agr. Expt. Sta. Bul. 252. Mar. 1956.

This bulletin brings the results up to date on tillage and crop residue management studies started in 1938 at the Tetonia Branch Station. It also corroborates or modified conclusions published in 1944. In addition to reporting the experimental results the bulletin contains a section devoted to the discussion of stubble mulch tillage and related phases of dryland farming in southern Idaho.

Smith, R. M., and Adams, J. E. WORKING BLACKLAND WET REDUCES YIELDS. Soil and Water. Jan. 1957.

Three years of experimental plot results plus other research observations and measurements afford convincing evidence that too much puddling and packing of wet clay soil in this area can be expected to reduce cotton, corn and perhaps other crop yields.

Blackland soil tends to have favorable properties unless structure is destroyed by farming practices. One good practice is to stay off of the land whenever it is wet, in order to allow favorable structure to express all possible benefits.

The results described were obtained during comparatively dry years. The wet August of 1955 followed a dry summer, seemed to help remedy the damage done during the previous spring season. In other years the research answers may be different, depending on the particular sequences of kinds of weather. In 1957 we hope to get a good sample of a wetter season in which to learn more about the results that may be obtained with plenty of moisture.

Smith, R. M., Robinson, F., and Thompson, D. O. SOIL COMPACTION CAN BE CURED. What's New in Crops & Soils, Vol. 7, No. 4. Jan. 1955.

How can we remedy compaction pans? The best way is to work with Nature rather than against her. Dynamic soils, like we have in the Texas Blackland, tend to cure themselves naturally, if given an opportunity.

Natural shrinkage in the soil, plant roots, crop residues, earthworms and other organisms all tend to loosen the surface soil. When these tendencies are not defeated by poor farming practices, even heavy soils will retain a desirable looseness.

Forage crops, especially tall grasses and sweetclovers in our area, are useful in correcting compaction pans. Their root system are strong, and their use does not involve so many procedures that tend to form pans.

But it is a mistake to say that a pan is caused by cotton, or that it is cured by clover or grass. From all evidence at hand, it is possible to grow large acreages of cotton and other row crops without forming serious compaction pans. Good practices and careful timing of field operations is the answer. At the same time, severe pans can be formed by overgrazing or other abuse of even the best forage combinations.

Mechanical shattering may help in many cases, but it is not a complete cure. Frequently, large blocks of dense soil will remain intact after the compaction pan is shattered with chisels or similar implements.

It is much easier to control erosion, keep the soil in excellent condition, and get maximum yields in this area, when good rotations are followed. On the other hand, careless farming practices--such as getting on the land when it is too wet--can cause strong compaction pans in the best of rotations.

The real solution is to arrange all crops and practices in such a way as to take full advantage of natural soil tendencies. These dynamic properties can make and keep our soils productive, if we will give them a chance.

Swanson, C. L. W., and Jacobson, H. G. M. EFFECT OF ADEQUATE NUTRIENT SUPPLY AND VARYING CONDITIONS OF CULTIVATION, WEED CONTROL, AND MOISTURE SUPPLY ON SOIL STRUCTURE AND CORN YIELDS. Agron. Jour. 49: 571-577. 1957.

Experimental data obtained over a 3-year period with field plots located on Cheshire sandy loam indicate that in humid climates under irrigated conditions with adequate fertilization, it is not necessary to clean cultivate to obtain maximum corn yields, provided the structure of the soil is maintained at an optimum. Under these conditions, one cultivation or use of herbicide may be adequate.

Telischi, Baba, McColly, H. F., and Erickson, E. DRAFT MEASUREMENT FOR TILLAGE TOOLS. Agr. Engr. 37(9): 605-508, 617. Sept. 1956.

The relationships between the draft requirements and several variables were determined by means of laboratory methods in order to study the draft requirements of tillage tools. The application of the theory of dimensional analysis to the problem seems satisfactory.

Weber, C. R., and Horner, T. W. ESTIMATES OF COST AND OPTIMUM PLOT SIZE AND SHAPE FOR MEASURING YIELD AND CHEMICAL CHARACTERS IN SOYBEANS. Agron. Jour. 49: 444-449. 1957.

Seed yield was 6 to 28 times more variable than chemical characters (oil, protein, iodine number). Use of incomplete block designs and other considerations justified long, narrow plots. Total cost (in hours) was 39.0% for obtaining yield and 61.0% for chemical attributes. Optimum plot size, apportioning cost among characters, was 3.2 times the basic unit (8 X 2 feet). Yield required 33, 50 and 700 times more replication than oil, protein and iodine number for comparable precision.

Zingg, A. W., and Whitfield, C. J. STUBBLE-MULCH FARMING. Tech. Bul. 1166. U. S. Dept. Agr. Oct. 1957.

The purpose of this bulletin is to summarize the results of experiments dealing with stubble-mulch tillage in the Western States. Because of differences in results obtained at the various locations, it was necessary to appraise and interpret available data, in order to define conditions under which the stubble-mulch practice was successful in controlling erosion, reducing runoff, and increasing crop yields. This summary should point the way to improved methods that will overcome deficiencies in the present system. It should also emphasize the need for intensified studies on factors related to the successful use of stubble-mulch tillage.

Equipment

Anonymous. A SELF-PROPELLED FORAGE PLOT HARVESTER. Agron. Jour. 49: 56-57. 1957.

The harvester was built around the power unit of an Allis-Chalmers Model G tractor. Successful features of commercial forage harvesters were incorporated in the design. The conventional front end of the tractor, including wheels, steering gear, and implement support, was removed by loosening four bolts. A new front end, consisting of a modified Ford automobile front axle, cable-control steering gear, and channel iron frame, was built as an integral part of the forage harvester. The harvester consists, in principle, of a cutting, collecting, and elevating mechanism, mounted on the new front end of the tractor and powered by the belt pully.

Corley, T. E., Helms, J. O., Kummer, F. A., and Stokes, C. M. PREPARING LAND FOR MECHANIZATION IN THE SOUTHEAST. Agr. Engin. 38: 730-733. 1957.

This article illustrates the important role an agricultural engineering experimental farm played in advancement of mechanization on the rocky and rolling land of the Southeast.

Schwab, G. O., Everett, R. K., and DeVries, L. L. TITLE-TRENCHING MACHINE PERFORMANCE. Agr. Engin. 37(7): 469-472. July 1956.

Data on performance and operating costs of title-trenching machines, gathered over a four-year period, provide valuable aids in evaluating the economics of machine tiling.

CROPS

General

Hendricks, S. B., Borthwick, H. A., and Downs, R. J. PIGMENT CONVERSION IN THE FORMATIVE RESPONSES OF PLANTS TO RADIATION. Proc. Natl. Acad. Sci. 42(1): 19-26. Jan. 1956.

Variations of physiological response with the fraction of pigment conversion as obtained from the reversibility and the first-order character of the conversion with respect to energy in the controlling reversible photoreaction were measured for internode lengthening and seed germination. Knowledge of this fraction permitted calculation of absorption coefficients and quantum efficiencies for pigment conversion. The method is a general one applicable to photoperiodism and other responses controlled by the reversible photoreaction.

Day, A. D., and Dickson, A. D. EFFECT OF ARTIFICIAL LODGING ON GRAIN AND MALT QUALITY OF FALL-SOWN IRRIGATED BARLEY. Agron. Jour. 50: 338-340. 1958.

Artificial 45° lodging of spring barley grown as a winter annual under flood irrigation had little effect on barley and malt quality. Lodging at 90° caused increases in barley nitrogen, malt nitrogen, wort nitrogen, diastatic power, and alpha-amylase; decreases in barley and malt kernel weights, and malt extract percentage; but had very little effect on the ratio of wort nitrogen to malt nitrogen, or of beta-amylase to alpha-amylase.

Duncan, W. G. THE RELATIONSHIP BETWEEN CORN POPULATION AND YIELD. Agron. Jour. 50: 82-84. 1958.

The logarithm of the average yield of individual corn plants making up a population bears a linear relationship to the population. Therefore, only two yield-population values are needed to estimate yields at any other population within the linear range. Equations are given for estimating maximum yield and maximum-yield population.

Erdman, L. W., Johnson, H. W., and Clark, F. VARIETAL RESPONSES OF SOYBEANS TO A BACTERIAL-INDUCED CHLOROSIS. Agron. Jour. 49: 267-271. 1957.

The degree of susceptibility of 40 varieties of the soybean (Glycine max L.) to a bacterial-induced chlorosis is reported. Ten varieties showed no chlorosis when given selected inoculants in greenhouse tests; 7 others proved to be neglibibly susceptible; 11 varieties showed a light or variable susceptibility; 6 were highly susceptible. The results are discussed in relation to nodulation and symbiotic nitrogen fixation and yield.

Green, V. E., Jr. THE CULTURE OF RICE ON ORGANIC SOILS--A WORLD SURVEY. Agron. Jour. 49: 468-471. 1957.

According to recent literature organic soils are being used more widely to grow rice. Unusual problems have arisen and much progress is being made toward their solution. The advantages and disadvantages of organic soil as a medium for rice are given also. The effects of rice culture on the peat are presented.

Hanks, R. J., and Thorp, F. C. SEEDLING EMERGENCE OF WHEAT, GRAIN SORGHUM, AND SOYBEANS AS INFLUENCED BY SOIL CRUST STRENGTH AND MOISTURE CONTENT. Soil Sci. Soc. Amer. Proc. 21: 357-359. 1957.

A technique was devised for studying plant seedling emergence through soil crusts where soil crust strength, soil moisture content, and soil type could be varied independently. Wheat, grain sorghum, and soybeans were studied with crust strengths from 0 to 1,400 millibars (as measured by the modulus of rupture) and soil moisture content from field capacity to 1/4 available (1/4 of the available water remaining in the soil). Preliminary tests were made to determine the reliability of the modulus of rupture as a measure of crust strength with respect to seedling emergence.

Wheat seedling emergence was not influenced by seed spacing or crust thickness for a wide range of crust strength as measured by the modulus of rupture. It was concluded from this study that the modulus of rupture is a good measure of crust strength as related to seedling emergence of wheat and similar plants.

Soil crust strength limiting seedling emergence for the plants studies was dependent on the soil moisture content. At a given crust strength, seedling emergence was lowest where the soil moisture content was lowest. At constant moisture content, seedling emergence decreased with increasing crust strength for the plants and soils studied. However, partial seedling emergence occurred on all treatments even where crust strength was as high as 1,400 millibars.

Kingsley, A. F., Clagett, C. O., Klosterman, H., and Stoa, T. E. LOSS OF MINERALS FROM MATURE WHEAT AND FLAX BY SIMULATED RAIN. Agron. Jour. 49: 37-39. Jan. 1957.

Simulated rain removed relatively small amounts of minerals from ripe wheat and flax plants which had been grown under field conditions. On the other hand, considerably greater amounts of minerals were leached, under the same conditions, from ripe wheat plants grown in the greenhouse. Pot watered, greenhouse plants, showed more leachable mineral elements at the ripe stage, than foliage wetted plants, suggesting that leaching is a continuous process.

Laude, H. H., and Pauli, A. W. INFLUENCE OF LODGING ON YIELD AND OTHER CHARACTERS IN WINTER WHEAT. Agron. Jour. 48: 452-455. 1956.

Yields were reduced about one-third due to lodging 1 to 2 weeks before heading and 1 to 2 weeks after heading. Lodging between those periods caused less reduction averaging 15 percent just before heading. Early lodging mainly reduced the number of kernels per head and later lodging reduced the size of the kernel. Protein content of the grain was higher in lodged than standing wheat. The total amount of protein per acre, however, was less in lodged areas.

Pool, M., Patterson, F. L., and Bode, C. E. EFFECTS OF DELAYED HARVEST ON QUALITY OF SOFT RED WINTER WHEAT. Agron. Jour. 50: 271-275. 1958.

Soft red winter wheats decreased significantly in test weight, increased significantly in kernel softness, and increased in amount of fine flour produced during milling of samples obtained over a delayed harvest period of about 45 days. Protein and ash percentages were unchanged. Small changes occurred in flour viscosities, dough mixing characteristics and in cookie size and top grain.

Willis, W. O., Larson, W. E., and Kirkham, D. CORN GROWTH AS AFFECTED BY SOIL TEMPERATURE AND MULCH. Agron. Jour. 49: 323-328. 1957.

Increases in soil temperature accelerated rate of emergence, rate of growth, and promoted earliness in corn. Corn growth rates approximately followed the Van't Hoff law, the Q_{10}° C. of that law being from 2.0 to 2.8 for the average temperature range tested, 60° to 80° F. Corn yields appeared to increase with increases in soil temperature. The most favorable soil temperature at the 4-inch depth for corn growth in central Iowa appears to be about 75° F.

Zuber, M. S., Grogan, C. O., Michaelson, M. E., Gehrke, C. W., and Monge, J. F. STUDIES OF THE INTERRELATION OF FIELD STALK LODGING, TWO STALK ROTTING FUNGI, AND CHEMICAL COMPOSITION OF CORN. Agron. Jour. 49: 328-331. 1957.

Susceptibility to stalk lodging was positively associated with ash, cellulose, potash, and silica but was not associated with susceptibility to Diplodia zeae or Gibberella zeae. Diplodia was negatively associated with ash, crude fiber, lignin, and cellulose but was positively associated with nitrogen. Giberella was similarly associated except no relation with ash or lignin was found.

Pasture and Range

Anthony, W. B., Boseck, J. K., Harris, R. R., Parks, P. F., Evans, E. M., and Grimes, H. W. FROM BEEF CALF TO FAT STEER IN TEN MONTHS ON OAT GRAZING AND DRY LOT FEEDING. Ala. Agr. Expt. Sta. Prog. Rpt. Ser. 67. June, 1957.

Starting with a lightweight, beef-type stocker calf in November a 935-pound fat steer was produced for market in 10 months. Oat grazing furnished good feed for the young test cattle as evidenced by the fact that the average daily gain during the oat grazing period of 188 days was 1.57 pounds. The animals fattened some in addition to growing while consuming the oat forage diet and graded Standard off grazing. It was necessary for the cattle to be pulled off grazing for a total of 46 days during the early winter. When off grazing the cattle were fed sorghum silage and a limited amount of corn and cottonseed meal. The kind of supplemental feed provided proved to be very satisfactory because of its low cost and the good performance of the cattle when they were off grazing.

After oat grazing the animals were fed in dry lot for 115 days during the summer. Cattle fed sorghum silage and limited grain for a part of the dry lot feeding period consumed a total of 15 bushels of corn per head and gained 244 pounds. Cattle fed on silage but a full head of a mixed corn-cottonseed meal-molasses-hay ration consumed a total of 27 bushels of corn per head and gained 271 pounds. To produce 100 pounds of gain, the feed replaced by silage had a market value of $7.14 or the feed replacement value of silage per ton was $14.29.

During the period of approximately 10 months that the cattle were owned on the farm, the net value per head above feed cost was increased $72.01. This represents a return to cover such cash and non-cash costs as labor, repairs, depreciation on facilities, sprays, and returns to capital and investment.

Baird, D. M., and Sell, O. E. THE PERFORMANCE OF BEEF CATTLE ON WINTER PASTURES IN THE GEORGIA PIEDMONT. Ga. Agr. Expt. Sta. Bull. N. S. 36. Dec. 1956.

The studies reported here were conducted to investigate relative merits of the three major types of winter pasture for fattening beef cattle. Pasture differences that needed clarification were: (1) production in terms of beef cattle gains, including quality of these gains: (2) pasture costs and returns on each type pasture; and (3) time, length, and dependability of grazing produced by these forages.

Branson, F. A., and Lommasson, T. QUANTITATIVE EFFECTS OF TWENTY-THREE YEARS OF CONTROLLED USE ON MOUNTAIN RANGE. Jour. Range Mgt. 11: 67-70. 1958.

Yields of species (determined by clipping and weighing separately for each plot) were determined on a mountain range near Bozeman, Montana in 1932 and in 1955. Previous to 1926 this range had been heavily grazed by sheep and cattle. In 1928 controlled use including proper stocking, open herding, one-night bed ground, and uniform distribution of grazing, was started on the forest allotment and continued through 1955.

Yields increased greatly on the lowest plot and the two at intermediate elevations but decreased slightly on the highest of the study area. These higher areas where slopes are steep and soils are relatively unstable need careful management to bring about desired improvement in production. The data clearly show that over most of the area, forage production had increased. High precipitation in the years previous to 1955 and low precipitation in years previous to 1932 partially explain this marked increase in total yields, but some of the increase must be attributed to better management practices.

Species that increased, decreased, or invaded the range during the 23-year period are discussed.

Burton, G. W., and Prine, G. M. FORAGE PRODUCTION OF RYE, OATS, AND RYEGRASS AS INFLUENCED BY FERTILIZATION AND MANAGEMENT. Agron. Jour. 50: 260-262. 1958.

Over a 3-year period, Abruzzi rye produced more forage than Southland oats at applied nitrogen rates of 0, 50, 100, 200, and 400 pounds per acre. Domestic ryegrass made little growth at low nitrogen rates, but outyielded oats at the 400-pound rate. All three species responded to phosphorus and potassium. Forage yields were increased by cutting at bimonthly, rather than monthly, intervals. Application of nitrogen increased the protein content of all species.

Cooper, C. S. A LEGUME FOR NATIVE FLOOD MEADOWS: I. ESTABLISHMENT AND MAINTENANCE OF STANDS OF WHITE-TIP CLOVER (T. variegatum) IN NATIVE FLOOD MEADOWS AND ITS EFFECT UPON YIELDS, VEGETATIVE AND CHEMICAL COMPOSITION OF HAY. Agron. Jour. 49: 473-477. 1957.

Establishment of annual white-tip clover in native flood meadows increased hay yields and quality. Seed scarification reduced the amount of seed necessary to obtain stands. Clover stand density increased with seeding rate and with phosphorus levels but was not affected by nitrogen levels. Clover proportion in hay was not affected by seeding rate. Phosphorus increased stands and yields of clover. Early cutting resulted in higher yields of crude protein per acre, and allowed for regrowth. However, clover stands should be maintained by delaying harvest periodically to allow for seed dissemination and restocking of the hard seed.

Cooper, C. S. THE EFFECT OF SOURCE, RATE, AND TIME OF NITROGEN APPLICATIONS UPON THE YIELDS, VEGETATIVE COMPOSITION, AND CRUDE PROTEIN CONTENT OF NATIVE FLOOD-MEADOW HAY IN EASTERN OREGON. Agron. Jour. 48: 543-545. 1956.

Nitrogen increased yields of native flood-meadow hay. A decrease in clover composition by weight with nitrogen fertilization was accompanied by a decrease in crude protein content of hay. Fall and spring applications of nitrogen were equally effective.

Decker, A. M., Jr., and Ronningen, T. S. HEAVING IN FORAGE STANDS AND IN BARE GROUND. Agron. Jour. 49: 412-415. 1957.

The amount of heaving during the winter and early spring was related to soil temperature changes as well as the uniformity and density of plant cover. Heaving damage to Ladino clover closely paralleled the upward movement of wooden dowels placed in the plot area. Other established forage species tested were not affected by this frost action.

Dix, R. L. SOME SLOPE-PLANT RELATIONSHIPS IN THE GRASSLANDS OF THE LITTLE MISSOURI BADLANDS OF NORTH DAKOTA. Jour. Range Mgt. 11: 88-92. 1958.

The roles of slope and exposure in determining the species composition of some grassland types in the Badlands of the Little Missouri River of North Dakota were investigated. Four stands, differing in slope and exposure, were selected as study areas; the stands and slopes and exposures of: 16° E., 8° E., 3° W., and 11° W.

The stands were sampled by the frequency method employing 40 1/4-M.^{2} quadrats per stand. Slopes and exposures were also measured. Similarity co-efficients between the stands were calculated and an ordination of stands established.

The behavior of the dominant species along this ordination indicated that it was based upon a moisture gradient. Blue grama and western wheatgrass, species of the more xeric Great Plains, were found to be more important at one end of the gradient, while little bluestem, side-oats grama, and plains muhly, species of the more mesic Midwestern prairies, were more important at the opposite end of the ordination. This ordination also correlated with apparent soil moisture, total number of species which occurred in the quadrats and in the total frequency per stand.

The relationships between the stands appeared not to be successional, since the species composition of the stands was based principally upon physiographic and edaphic factors.

Duell, R. W., and Gausman, H. W. THE EFFECT OF DIFFERENTIAL CUTTING ON THE YIELD, PERSISTENCE, PROTEIN, AND MINERAL CONTENT OF BIRDSFOOT TREFOIL. Agron. Jour. 49: 318-319. 1957.

Highest yields of birdsfoot trefoil were obtained when harvested at 1/10 bloom. Yields were lower when cut at 3 inches height as compared with 1 inch. Cutting at 1 inch height and 20-day intervals for 2 seasons reduced plant population. The percent of protein and minerals declined with maturity, but maintained relatively high levels at maturity. Notable exceptions occurred in the decline of P, K, and Ca with maturity.

Evans, R. A., and Love, R. M. THE STEP-POINT METHOD OF SAMPLING--A PRACTICAL TOOL IN RANGE RESEARCH. Jour. Range Mgt. 10: 208-212. 1957.

The step-point method of sampling consists of procedures for determining total ground cover and percentage cover of the herbaceous species in the stand. Involved in the procedure is the point method using individual points and an estimate method utilizing a square-foot frame. Predetermined sampling designs are used in the sampling procedures.

In comparisons among data of different operators sampling the same acre area standard deviations of total ground cover and botanical composition measurements are of low magnitude. Also data of total ground cover and botanical composition from the step-point method were comparable to that of the point-frame method. The time required to sample an area with the step-point method was about one-sixth to one-eighth as much as required by the point-frame method.

From comparisons presented in this paper and from three years of field experience with the method, it is felt that the degree of accuracy and objectivity are suitable for valid analyses of field plots and are comparable to other methods. Of prime importance is the short time in which areas can be sampled using this method. The latter point in many cases is the factor which will mean success or failure of range experimentation, particularly in respect to long-term continuity of the collection of data.

Gilbert, F. A., Bowers, A. H., and Sanders, M. D. EFFECT OF NITROGEN SOURCES IN COMPLETE FERTILIZERS ON BLUEGRASS TURF. Agron. Jour. 50: 320-323. 1958.

A single spring application of fertilizer containing both quickly and slowly available nitrogen produced a greater summer weight of grass than either regular fertilizer or sewage sludge with equivalent nitrogen contents. The advantage was more pronounced when clippings were removed than when they were retained. Summer grass yields were greatest when a spring fertilizer-application was supplemented by additional summer treatments.

Harper, H. J., and Gray, F. EFFECT OF SEVEN ANNUAL LEGUMES ON THE YIELD OF CORN AND OATS ON NORGE LOAM. Agron. Jour. 49: 293-296. 1957.

Oat yields were increased more than corn yields when residue from legumes grown in a 3-year rotation with these crops was returned to a reddish prairie soil in Central Oklahoma. However, the average production of corn over a 24-year period was higher than the average production of oats. Although seasonal rainfall in this area is more favorable for oats than for corn, soil temperature is more favorable for rapid decomposition of organic matter when corn is growing rapidly than when oats is making its most rapid growth. Consequently, a higher soil fertility level is needed for the maximum production of oats than for corn under the climatic environment that prevails in this sub-humid region.

Henderson, H. A. PASTURES AND PASTURE PRACTICES: PASTURES ON HAYWOOD COUNTY, TENNESSEE, FARMS - HOW THEY WERE PRODUCED AND USED. Tenn. Agr. Expt. Sta. Bul. 272, 14 pp., illus. Sept. 1957.

A survey of 24 livestock farms with some improved pasture in the Brown Loam area of Tennessee showed that on the average 168 acres were grazed. Of the 29 farmers interviewed, 5 reported no improved pasture. Of the acreage grazed, 72 acres were in perennial pasture, 29 of which were improved. The average farm had also 50 acres of aftermath grazing, almost 30 acres of summer and winter supplementary pasture, and 15 acres of woodland pasture. Many farmers in the sample were not following the practices recommended by the College of Agriculture for establishing and maintaining the improved pastures reported on their farms. Soils were tested on a third of the fields but not all farmers followed the recommendations of the soil-testing laboratory. Soil amendments were used on only two-thirds of the fields during establishment of the pasture. Only half the fields were ever clipped to control weeds and many of these were clipped only infrequently. Oats seeded in mixtures made up the most popular supplementary pasture. An average of 300 pounds of 6-12-12 per acre was applied on about 40 percent of the supplementary pastures. Most farmers thought their pasture programs would be adequate for their livestock if weather was "average" or better. With poor weather, only 15 percent of the farmers expected to have adequate pasture.

Jackobs, J. A., and Hittle, C. N. VARIATIONS AMONG SEEDLOTS OF CERTIFIED LADINO CLOVER AND OTHER WHITE CLOVERS. Agron. Jour. 50: 327-330. 1958.

Differences in plant size, flowering, winter survival, and leafhopper damage in Ladino and white clover seedlots indicated that the system of seed certification, from which the Ladino lots were selected, was inadequate to insure that all seedlots were the same genetically. Larger plants flowered later in the season than smaller plants. Numerous leafhopper-resistant plants were found in the comparatively susceptible Ladino. There was a positive correlation of fall vigor with petiole diameter, winter survival, and leafhopper damage.

Jackson, J. E., and Burton, G. W. AN EVALUATION OF GRANITE MEAL AS A SOURCE OF POTASSIUM FOR COASTAL BERMUDAGRASS. Agron. Jour. 50: 307-308. 1958.

Finely crushed granite meal was an inferior source of potassium for Coastal Bermudagrass on a potash-deficient Kershaw sand. One unit of K_2O in muriate of potash supplied as much available potassium as 8 units of K_2O in granite meal.

Kik, M. C., and Staten, R. D. THE NUTRIENT CONTENT OF FESCUE AND ORCHARDGRASS AND AMINO ACIDS IN OTHER GRASSLAND SPECIES. Agron. Jour. 49: 248-250. 1957.

Samples of several grasses and legumes were collected throughout the growing season, and analyses were run to determine the amount of vitamins, minerals, and amino acids contained in fescue and orchardgrass and the amino acid content in 20 other herbage species. The average values for all species are presented. The amino acid values are in percent of total crude protein. The vitamin content for fescue and orchardgrass includes all known members of the vitamin B complex.

Kilcher, M. R. THE PERFORMANCE OF THREE GRASSES WHEN GROWN ALONE, IN MIXTURE WITH ALFALFA, AND IN ALTERNATE ROWS WITH ALFALFA. Canad. Jour. Agr. Sci. 38: 252-259. 1958.

Crested wheatgrass, intermediate wheatgrass, and streambank wheatgrass, chosen for diversity of root type, were compared for yield and competitive ability when growing alone, in mixture with alfalfa, and in alternate rows with alfalfa. For each seeding method the order of the grass species yield performance was the same, but the magnitude of the yield difference varied by seeding methods. In pure stands the yield difference between the low and high producing grass was 50 percent, in mixture with alfalfa 170 percent, and in alternate rows with alfalfa 220 percent. The total yield was greatest in alternate rows and smallest in pure grass stands (fertilized). In 1954 grass and alfalfa growing in alternate rows outyielded grass and alfalfa in mixed rows by 4 percent; in 1955, by 10 percent; in 1956, a dry year, by 33 percent; and in 1957, an extremely dry year, by 137 percent. The relative stand of alfalfa to grass was greater when growing in alternate rows as compared to mixed rows. This relationship held for all grass species but was less pronounced for streambank wheatgrass, the least competitive species of the three grasses.

Kretschmer, A. E., Jr. NITRATE ACCUMULATION IN EVERGLADES FORAGES. Agron. Jour. 50: 314-316. 1958.

Oats and Italian ryegrass accumulate large quantities of nitrate but permanent pasture grasses and legumes do not. Oat stems contained more nitrate than leaves. Winter forages following summer clean fallow contained more nitrate than those following weeds. Time of season, daily low temperatures, and variations between daily low and high temperatures also affected nitrate contents.

Lance, H. M. THE SEEDLING EMERGENCE OF GRASSES AS AFFECTED BY LOW TEMPERATURE. Agron. Jour. 48: 558-560. 1956.

Cold tolerance of the grass seedling decreases with advancing stage of the preemergence period. Reduced tolerance is evidenced both by reduction and delay in emergence. Pre-emergence cold tolerance may be marked by seedling susceptibility to soilborne pathogens if these are not adequately controlled.

Laude, H. M., Kadish, A., and Love, R. M. DIFFERENTIAL EFFECT OF HERBAGE REMOVAL ON RANGE SPECIES. Jour. Range Mgt. 10: 116-120. 1957.

Herbage removal, timed with regard to the growth characteristics of individual species, offers a means which has not been adequately recognized, for manipulation of vegetation. Differences in behavior among the species of grass make this possible, and permit choice of management practices to encourage or discourage a given species or group of plants.

Range species react differently to grazing treatment. Grazing at such time as to reduce the seed production of one annual species more than another provides a way to limit the reseeding potential and, thus, the prevalence of the species in the vegetation. After herbage removal, soft chess was found to continue tillering and heading much longer than foxtail fescue. In such a comparison it would appear that early grazing could be continued to the growth termination stage of the fescue, thus depressing this species, yet this being early enough to permit later tillering and abundant heading in soft chess.

Animal preferences must be considered in determining the results of vegetation manipulation through herbage removal once these plants have headed out. For example, livestock do not graze the headed red brome as they do soft chess because of the obnoxious awns of the former. In effect, this would increase the seed of red brome relative to that of soft chess.

Among the variables which influence the success of herbage removal as a tool in range management are the inherent growth characteristics of the species, plant competition, selective grazing, and weather. Though the degree of control a rancher has over these variables is more or less limited, timed herbage removal, taking into account the growth characteristics of the species and the palatability preference of the grazing animal, can be advantageously employed.

Leefe, J. S. THE USE OF NITROGENOUS FERTILIZER IN THE PRODUCTION OF GRASSLAND HERBAGE. Canad. Jour. Agr. Sci. 38: 260-267. 1958.

Ammonium nitrate and calcium cyanamide were applied to an orchard grass, ladino clover sward over a 3-year period. Rates to give 0, 50, 100 and 150 lb. of nitrogen per acre were applied in two ways: single spring applications, and split applications, one-half in the spring and one-half immediately following an early first cutting.

Ammonium nitrate proved to be the more effective source of nitrogen whether measured by yield, crude protein of the herbage or net recovery of nitrogen.

Single spring applications of nitrogenous fertilizer gave greater seasonal total yields of dry matter and crude protein and more efficient net recovery of nitrogen than did split applications.

Where no nitrogen was applied there was an increase in the clover content of the sward, total yield of dry matter and the total yield of crude protein during the 3 years of the test. However, the greatest seasonal total from these plots did not equal that obtained from the highest rate of application of fertilizer nitrogen. The highest of the rates almost completely suppressed clover development but gave the greatest yields of dry matter and crude protein and the most efficient net recoveries of nitrogen.

Lewis, R. D., and Lang, R. L. EFFECT OF NITROGEN ON YIELD OF FORAGE OF EIGHT GRASSES GROWN IN HIGH ALTITUDE MEADOWS OF WYOMING. Agron. Jour. 49: 332-335. 1957.

Effects of 0, 80, and 160 pounds nitrogen per acre on forage production and percentage crude protein of eight seeded grass species and varieties in a high altitude meadow near Pinedale, Wyoming were studied.

Common, Lincoln and Manchar bromegrass, orchardgrass, timothy, intermediate wheatgrass, meadow foxtail and Reed canarygrass were studied. Variation in species and variety response to nitrogen were noted. However, significant increases in forage production and percentage crude protein were obtained for all eight grasses.

Lynd, J. Q., Graybill, F., and Totusek, R. GRAZING TRIAL EVALUATIONS USING PAIRED PASTURES WITH YEARLING STEERS. Agron. Jour. 49: 488-492. 1957.

The combined pooled variation between paired steers for all pastures during three years was 17.86 with C. V. of 12.3%. Effectiveness of the procedure is dependent upon: (1) a uniform experimental herd (2) a preliminary observation period, and (3) continuous sound stocking rate decisions throughout the grazing season.

Marshall, S. P. VALUE OF OAT PASTURE FOR DAIRY CATTLE. Fla. Agr. Expt. Sta. Bull. 584. April 1957.

This study of the feeding value, yield of total digestible nutrients per acre, and returns that may be anticipated from oat pasture was undertaken to aid dairymen in determining its usefulness in their feeding programs.

Myers, K. H. ANALYSIS OF GRASSLAND FARMING IN NORTHEASTERN PENNSYLVANIA. Pa. Agr. Expt. Sta. Bul. 627, 18 pp., illus. Dec. 1957.

Grassland farming has proved profitable on many dairy farms in this area, as shown in the study of 4 typical farms of different sizes and different amounts of labor and capital available. If increasing the acreage of grassland is to be profitable, it may be necessary to alter feeding practices to make effective use of additional pasturage and harvested forage; to provide space and facilities for additional cows and for hay or silage; to change the method of seeding; to provide material other than straw for bedding; to spread manure on grassland in such a way that the value of grasses or legumes for forage will not be impaired; and to obtain new equipment for harvesting hay or grass silage. Adoption of improved practices alone will almost double the income on a typical farm in this area. An all grassland cropping plan will further increase the income by about 37 percent, provided the dairy herd is expanded so the additional forage is consumed on the farm.

Nelson, M., and Castle, E. PROFITABLE USE OF FERTILIZER ON NATIVE MEADOWS. Jour. Range Mgt. 11: 80-83. 1958.

It is apparent from this study that any likely increase in range capacity can readily and profitably be matched by meadow output under a system of fertilization. However, Solution I indicates that without some development of range, the expansion through fertilization of meadow alone is limited to around 25 percent.

Norman, M. J. T. INTERVALS OF SUPERPHOSPHATE APPLICATION TO DOWNLAND PERMANENT PASTURE. Jour. of Agr. Sci. 47(2): 157-171. April 1956.

Superphosphate, at two levels and three intervals of application, was applied to calcareous downland pasture grazed by sheep over a period of 3 years. At the high level, total dry-matter and crude-protein yields were higher from a single initial application and from thrice-yearly applications than from annual applications. At the high level, mean herbage phosphate content and total phosphate yield were higher following a single initial application than when superphosphate was applied at shorter intervals. Superphosphate increased the cover of grasses and legumes and reduced the cover of herbs.

Pasto, J. K., Allison, J. R., and Washko, J. B. GROUND COVER AND HEIGHT OF SWARD AS A MEANS OF ESTIMATING PASTURE PRODUCTION. Agron. Jour. 49: 407-409. 1957.

Ground cover and sward height can be used to estimate forage production on permanent bluegrass and orchardgrass-Ladino clover pastures. Ground cover alone can be used to delineate bluegrass pastures of low forage productivity, but by itself is an unreliable yardstick for estimating production on either high producing bluegrass or on orchardgrass-Ladino clover pastures.

Petersen, R. G., Lucas, H. L., and Woodhouse, W. W., Jr. THE DISTRIBUTION OF EXCRETA BY FREELY GRAZING CATTLE AND ITS EFFECT ON PASTURE FERTILITY: I. EXCRETAL DISTRIBUTION. Agron. Jour. 48: 440-444. 1956.

The negative binomal distribution function is used to characterize quantitatively the time-space distribution of excreta from freely-grazing animals over long periods of time; the poisson distribution function was found to be reasonably accurate over short periods. Proportion of pasture covered by 0, 1, 2, ... excretions during a grazing period appears to depend primarily on mean excretal density at the end of the period, and to be practically independent of the size and shape of the pasture.

Petersen, R. G., Weswig, P. H., and Cowan, J. R. MEASURING PALATABILITY DIFFERENCES IN TALL FESCUE BY GRAZING SHEEP. Agron. Jour. 50: 117-119. 1958.

Consistent differences in apparent palatability among 20 genotypes of tall fescue were demonstrated by observing the behavior of a number of sheep grazing a replicated small-plot nursery. This observational technique was found to be preferred to clipping a sample of forage before and after grazing and estimating palatability by difference.

Petersen, R. G., Woodhouse, W. W., Jr., and Lucas, H. L. THE DISTRIBUTION OF EXCRETA BY FREELY GRAZING CATTLE AND ITS EFFECT ON PASTURE FERTILITY: II. EFFECT OF RETURNED EXCRETA ON THE RESIDUAL CONCENTRATION OF SOME FERTILIZER ELEMENTS. Agron. Jour. 48: 444-449. 1956.

Data indicate that freely grazing animals distribute fertilizer inefficiently, the degree varying with size of the area effectively fertilized by each excretion and with the rate of loss of each element after application. The greatest benefit from excretal return of such elements as P and K appears to be under conditions of high stocking rate and long periods of grazing time. Reliable values for such factors as effective area fertilizer excretion and rate of nutrient loss are needed to estimate the effect of grazing animals on the fertility status of a pasture.

Poyser, E. A., Hedlin, R. A., and Ridley, A. O. THE EFFECT OF FARM AND GREEN MANURES ON THE FERTILITY OF BLACKEARTH-MEADOW CLAY SOILS. Canad. Jour. Agr. Sci. 37: 48-56. 1957.

Green manure crops were ploughed down in the fallow year of a fallow, wheat, corn, wheat rotation to determine their effect on total organic carbon and nitrogen in the soil and on crop yields.

An average decrease of 27.9 percent of the organic carbon and 15.9 percent of the nitrogen in the soil occurred over a 25-year period. Under sweet clover and farm manure the levels of organic carbon and nitrogen were significantly higher than the levels of these constituents under fallow treatment. The levels of organic carbon and nitrogen were not significantly affected by weeds, buckwheat, corn, rye, peas and red clover green crop treatments.

There was little crop yield response to nitrogen-supplying green crops the first year after fallow. However, during recent years there was a gradual increase in yield response to nitrogen-supplying treatments in the second and third crops after fallow. This increased response to nitrogen probably reflected the gradual decline in the ability of the soil to supply nitrogen as total soil organic matter declined.

Ramage, C. H., Eby, C., Mather, R. E., and Purvis, E. R. YIELD AND CHEMICAL COMPOSITION OF GRASSES FERTILIZED HEAVILY WITH NITROGEN. Agron. Jour. 50: 59-62. 1958.

Annual dry matter yields of orchardgrass and reed canarygrass over a 3-year period ranged from 2 tons per acre with 50 pounds of nitrogen to 4.5 tons per acre with 400 pounds of nitrogen. The protein percentage of the dry matter increased from 12 to 20. Recovery of the nitrogen applied in 1954 was 59.7, 73.5, 62.0, and 58.7% for rates of 50, 100, 200, and 400 pounds of nitrogen per acre, respectively.

Schonhorst, M. H., Davis, R. L., and Carter, A. S. RESPONSE OF ALFALFA VARIETIES TO TEMPERATURES AND DAYLENGTHS. Agron. Jour. 49: 142-143. 1957.

Ten varieties and a mixture of alfalfa were grown at 60°, 70°, and 80° F. at 8-, 12-, and 16-hour daylengths for each temperature. Growth responses measured in cm. showed the greatest height differences at 60° F. and 12-hour daylength. At this temperature, the varieties and mixtures could be divided into three groups according to the magnitude of the variances. Varieties within each group were significantly different in height from varieties in other groups.

Stitt, R. E. FACTORS AFFECTING YIELD AND QUALITY OF DRYLAND GRASSES. Agron. Jour. 50: 136-138. 1958.

Yields of 7 species of grass were highly correlated with April-May precipitation (2.24 to 6.18 inches) during and 8-year period. Ladak alfalfa grown with crested wheatgrass increased total yields during the last 5 years of an 8-year period, owing possibly to nitrogen contributed by the alfalfa. Fifty pounds of nitrogen and 20 pounds P_2O_5

applied to 8-year-old stands increased yields of all species and mixtures. Renovation decreased yield during the treatment year and increased yields the year following.

Tulley, H. N. MODERATE GRAZING--KEY TO SUCCESSFUL RANCHING. Jour. Soil and Water Conserv. 12: 133-134. 1957.

Despite the dry weather some ranchers have been able to adjust their operations enough to last out the periods of drouth in Wyoming. Conservation practices contributed a big part of the success in these critical periods of drouth. The author reports the story of a Wyoming rancher and the reasons why he is making out better than most.

VanKeuren, R. W., and Heinemann, W. W. A COMPARISON OF GRASS-LEGUME MIXTURES AND GRASS UNDER IRRIGATION AS PASTURES FOR YEARLING STEERS. Agron. Jour. 50: 85-88. 1958.

In irrigated pasture studies with yearling steers, grass-legume mixtures produced greater beef yields per acre and higher average daily gains than grasses. Cattle that grazed the grass-legume pastures attained a higher degree of finish than those on the grass pastures. The ability of alfalfa to withstand grazing was shown by the high percentage of this legume in the pastures at the end of 3 years' of grazing.

Wallace, A. T., Killinger, G. B., Bledsoe, R. W., and Duncan, D. B. DESIGN, ANALYSIS AND RESULTS OF AN EXPERIMENT ON RESPONSE OF PANGOLAGRASS AND PENSACOLA BAHIAGRASS TO TIME, RATE AND SOURCE OF NITROGEN. Univ. Fla. Agr. Expt. Sta. Bul. 581. Feb. 1957.

Although several research workers have conducted fertility experiments with Pangolagrass and Pensacola Bahiagrass, the production capacity of these two grasses has never been fully determined. It was with this in mind that a detailed experiment involving rates of phosphorus and potassium and rates, sources and time of application of nitrogen was planned.

Weed, Brush, and Pest Control

Aldrich, R. J. EFFECT OF 2,4-D ON THE GROWTH AND YIELD OF OATS GROWN UNDER THREE LEVELS OF FERTILITY. Agron. Jour. 50: 145-148. 1958.

Plants in the minimum fertility level were relatively unaffected by 2,4-D in any stage. At the medium fertility level yields were reduced most by treatment during the seedling stage but were also reduced significantly by treatment during anthesis. Mean yields at the high fertility level were reduced significantly only by treatment during anthesis.

Blydenstein, J. THE SURVIVAL OF VELVET MESQUITE (_Prosopis juliflora_ var. _velutina_) AFTER FIRE. Jour. Range Mgmt. 10: 221-223. 1957.

The damage to velvet mesquite in southern Arizona by fires during different seasons was studied to appraise the theory that natural wildfires were formerly an important factor in preventing the spread of mesquite over the desert grassland, and to evaluate the use of controlled burning as a tool in the eradication of mesquite today.

The results from burns during both the dormant winter season and the active growing and flowering season indicate that single fires do not cause high mortality rates in mesquite, but many trees survive through basal sprouting only. A high degree of correlation was found to exist between size of tree and amount of damage, the smaller size-classes receiving the heaviest damage. Mortality was restricted to trees under 1 inch in diameter.

Heavy sprouting after total top-kill reduces the stem diameter of many of the trees, suggesting that recurrent fires might cause higher mortality rates. As a tool in eradicating established mesquite stands, fire appears uneconomical due to the need for recurrent burns and adequate fuel. In the control of young invading mesquite on grasslands the use of fire should be investigated further.

Carter, H. W., Norton, H. W., and Dungan, G. H. WHEAT AND CHEAT. Agron. Jour. 49: 261-267. 1957.

Cheat is a troublesome weed in many fields of winter cereals in south Central United States. Cheat plants, especially their roots, were found to grow slowly at first. This weed proved to be weakly competitive when grown in association with wheat in a thick stand. However, when wheat stands were thin, cheat plants tillered abundantly and produced large quantities of seed. Cheat, therefore, appears to be a plant opportunist. Even though a weak competitor, cheat was never killed outright by a thick stand of wheat, nor was it ever prevented by crop competition from developing some seed.

Meuggler, W. F., and Blaisdell, J. P. EFFECTS ON ASSOCIATED SPECIES OF BURNING, ROTOBEATING, SPRAYING, AND RAILING SAGEBRUSH. Jour. Range Mgt. 11: 61-66. 1958.

Four different methods of selective sagebrush control were studied on sagebrush-bunchgrass range at the U. S. Sheep Experiment Station near Dubois, Idaho. Burning, rotobeating, spraying with 2, 4-D, and railing were compared on adjacent areas to obtain a better understanding of relative effects upon associated native species and forage production.

Burning was the only treatment that injured any grasses. The Carex filifolia-Festuca idahoensis group was most severely reduced by burning. Other grasses, though set back temporarily, soon recovered. Grasses as a group were greatly favored by the other treatments. There was a lag in increased grass production the first year after rotobeating and railing, but grass production increased immediately without spraying.

Robertson, J. H., and Cords, H. P. SURVIVAL OF RABBITBRUSH, Chrysothamnus Spp., FOLLOWING CHEMICAL, BURNING, AND MECHANICAL TREATMENTS. Jour. Range Mgmt. 10: 83-89. 1957.

These experiments, coupled with records of scattered attempts to control rabbitbrush, show that results tend to be erratic. The factors responsible are not well understood. At present, the only "one-shot" treatment that can be recommended is rootplaning. This practice must be applied in the spring when soil moisture following snow melt has been nearly exhausted. The shrubs should be knocked over to prevent rerooting. If the herbaceous understory is to be preserved, the date should be earlier than otherwise. Limitations imposed by rocks and costs point to the need for methods that are more widely applicable.

Repeat treatments involving either burning followed by the use of 2, 4-D spray the following year or spraying the same area in successive years, appear to offer a good chance of consistent success.

Plowing usually has not been successful in the control of rabbitbrush for range seeding. The use of controlled burning in areas with a thick enough stand to carry a fire should be considered as a means of seedbed preparation. Wild fire in rabbitbrush sometimes offers a good chance for seeding grasses. If resprouting occurs, the use of 2, 4-D sprays should then result in good control. Grasses that have been established in the meantime should not be seriously injured.

In some areas, plowing or brushbeating before seeding has resulted in moderate to good control of big sagebrush, but has allowed rabbitbrush to become dominant. In such cases, root planing or spraying with 2, 4-D may provide the necessary control. Terrain, economic, and management factors would determine the proper alternative.

Weber, C. R., and Staniforth, D. W. COMPETITIVE RELATIONSHIPS IN VARIABLE WEED AND SOYBEAN STANDS. Agron. Jour. 49: 440-444. 1957.

Growth of annual weeds increased markedly and bean yield reductions became more severe with soybean stands of less than 9 to 11 plants per foot of row. Bean yield reductions were more severe when weeds were left until or after stage 7 (early August). With moderate weed infestations and moisture deficits during the growing season, soybean yield reductions were less than with adequate moisture. Foxtail and smartweed infestations reduced bean yields about equally. Dry matter yields of above-ground plant parts of soybeans and weeds together were slightly higher than that of weed-free beans.

Wiese, A. F., and Rea, H. E. TREATING IRRIGATED SORGHUM WITH 2,4-D. Agron. Jour. 50: 309-310. 1958.

Sorghum at the flowering stage was susceptible to all rates of 2,4-D. Applications of 1/2 pound per acre of either 2,4-D ester or amine did not reduce yields of sorghum at other stages of growth. One or two pounds of 2,4-D acre supplied immediately after irrigations tended to reduce sorghum yields.

Forestry, Woodlots, Shelterbelts

Cooper, C. F. THE VARIABLE PLOT METHOD FOR ESTIMATING SHRUB DENSITY. Jour. Range Mgt. 10: 111-115. 1957.

The variable-plot method can be used to estimate shrub density in percent without measurement of distance or area. This method is faster and easier to apply than any of the standard shrub-estimating procedures now in common use. In tests in three different vegetation types, it closely approximated the estimates obtained by other sampling methods. It is most reliable in open shrub stands with a density of less than 35 percent; beyond that point accuracy falls off rapidly. Variable-plot data are subject to statistical analysis, and are particularly useful in calculating an index of dispersion. The variable-plot method appears to be a practical means of reducing the labor required in collecting field data on shrub density.

Shoulders, E. TIMBER STAND IMPROVEMENT IN OZARK FORESTS--AN APPRAISAL AFTER 15 YEARS. Jour. Forestry 54: 824-827. 1956.

The development of these Ozark forests in the first 15 years following stand improvement both justifies the work and indicates how quality growth could have been further increased.

The benefits are most noticeable in the understory, which has improved greatly in basal area and in stem quality. The improvement was in more or less direct proportions to the amount of overstory removed. Cleaning around understory crop trees also stimulated growth, but only when done in conjunction with liberation from overstory competition.

White, D. P. AERIAL APPLICATION OF POTASH FERTILIZER TO CONIFEROUS PLANTATIONS. Jour. Forestry 54: 762-768. 1956.

This report describes a successful application of potash fertilizer to over one hundred acres of coniferous plantations in New York.

Improved growth coupled with increased foliage and soil potassium levels indicates that the treatment was effective in stimulating increased physiological activity in the stands. Of more direct import was the uniform and consistent distribution of the fertilizer by the aerial application technique. These experiments showed that an application rate of 200 pounds per acre could be achieved readily with the equipment used.

Williston, A. L., and Huckenpahler, B. J. RESPONSE OF SIX CONIFERS IN NORTH MISSISSIPPI UNDERPLANTINGS. Jour. Forestry 56(2): 135-137. 1958.

In north Mississippi, fifth-year results of four consecutive years of underplanting ridge hardwoods with six conifers show that immediate release from hardwood competition greatly stimulates the height growth of seedlings. Seedlings on the released plots are almost three times as tall as those on unreleased plots. Release slightly improved the survival of loblolly, shortleaf, and longleaf pine.

Loblolly pine appears to be the best of six species tested for restocking depleted hardwood stands on dry loessial ridges. When released, it has survived as well as shortleaf and Virginia pines and nearly as well as eastern red-cedar, and has substantially outgrown all three during the first five years.

Yamaoka, Y. THE TOTAL TRANSPIRATION FROM A FOREST. Amer. Geophys. Union Trans. 39: 266-272. 1958.

The investigation on the relation between total leaf weight and breast-height diameter is necessary to estimate the total transpiration. The method of estimating the total leaf weight of Cryptomeria japonica was discussed, and this was found to be proportional to the square of the breast-height diameter. The relations between transpiration rate and the meteorological elements regarding to this species were also investigated, and the empirical formulas necessary to estimate the total transpiration were obtained. Finally, a stand of 740 Cryptomeria japonica (4376 sq m; about 1.1 ac) 45 years old was selected, for example, and the total leaf weight was estimated at 69 tons and the total transpiration at 1.80 ton/hour in case of air temperature, 26.6° C; relative humidity, 80 pct; wind velocity, 3.5 m/sec; and radiation intensity, 1 cal/cm^2 min. This value was compared with the water loss from various types of surfaces to show no serious error exists in our estimation.

The relations between leaf temperature and transpiration rate and meteorological elements were also investigated.

Zahner, R. MAPPING SOILS FOR PINE SITE QUALITY IN SOUTH ARKANSAS AND NORTH LOUISIANA. Jour. Forestry 55: 430-433. 1957.

This paper briefly summarizes the soil-site relationships for loblolly and shortleaf pine in South Central Arkansas and North Central Louisiana, and illustrates how these findings can be applied for mapping site quality on large areas of forest land.

Site index (height of trees in feet at age of 50 years) and soil and topographic data from 206 well-stocked 40- to 60-year-old stands of loblolly and shortleaf pine were subjected to rigorous statistical analysis. Results showed that site index is closely related to three site factors: (1) surface soil thickness or texture, (2) subsoil texture, and (3) slope.

Economics of Conservation

Ball, A. G., Heady, E. O., and Baumann, R. V. ECONOMIC EVALUATION OF USE OF SOIL CONSERVATION AND IMPROVEMENT PRACTICES IN WESTERN IOWA. U. S. Dept. Agr. Tech. Bul. 1162, 91 pp., illus. June 1957.

Experimental data from the Western Iowa Experimental Farm near Castana and the Page County Experimental Farm indicate that conservation practices differ in effects on yield, ability to control erosion, and costs of adoption. Although accurate appraisal of relative merits of various practices in terms of soil saved or conservation obtained per dollar invested is not possible from the data available, the data do point the way. Tentative ordering of individual practices on the basis of their ability to save soil is as follows: On slopes that exceed 12 percent, contour listing is most effective of the practices considered, followed in order by terracing, contouring, and rotations. On lower slopes, the order is terracing, followed by contour listing, rotations, and contouring. These practices differ as to the initial costs associated with their adoption. On rotations that do not include meadow, contouring and contour listing rank highest in terms of soil saved per dollar invested. If practices are complementary, they conserve soil only if used in combination. Net incomes from crops are higher for any rotation or any system of farming on farms located on the less steep slopes and the more fertile soil. Using 3 case farms, the writers worked out a crop program and 8 livestock programs for each farm for the years from 1952 to 1967, inclusive. The minimum time required for a soil conservation plan to provide a higher net farm income than extension of the present plan is 4 years under asumption of steady prices and 5 years under assumption of declining prices. For accumulated net farm income under a conservation plan to exceed accumulated net farm income under the present plan would take 7 years at 1952 prices.

The additional capital required for a conservation system of farming is greatest 5 to 8 years after the new plan is started. Heavy applications of fertilizer in the first few years of such a plan will help to overcome the drop in net farm income that ordinarily occurs. Credit will be needed. Overall farm planning for conservation is necessary. In this, education must play an important role.

Bauknight, L. M. DIVISION OF COSTS AND RETURNS UNDER DIFFERENT TENURE ARRANGEMENTS AND DIFFERENT PRICE AND PRODUCTIVITY LEVELS. S. C. Agr. Expt. Sta. Bul. 422. Southeast Regional Land Tenure Com. Pub. 16.

The budget method of analysis was used in this study to determine the distribution of costs and returns to landlords and tenants under different rental arrangements on three sizes of cotton farms and under different assumptions as to prices and yields. Under this method, a high price-high yield situation appears to result in about 55 to 60 percent of net farm income going to sharecroppers with no significant difference resulting from size of farm. They would receive from 62 to 73 percent of the labor income. In a high price--low yield situation the landlord would receive a minus labor income. That is, the sharecropper's share would be larger than the total for the farm. Instead of a two-thirds and one-third division of total net farm and labor incomes going to hoe-hands, these workers could expect at least half the net farm income under the most favorable price and yield situation and an even larger percentage under other situations. It is not intended to suggest that these divisions of income are inequitable. However, in working out tenure arrangements, greater consideration should be given to prospective prices and yields.

Bonser, H. J., and Davis, J. F. ELECTRICITY ON FARMS AND IN RURAL HOMES IN THE EAST TENNESSEE VALLEY. Tenn. Agr. Expt. Sta. Bul. 221. Apr. 1951.

This report covers one segment of a broad investigation of some of the economic aspects of farm electrification. It is based on a study of the use of electricity on 492 farms and 79 rural nonfarm residences in East Tennessee. Dwellings of operators and about half of the other houses on these farms were wired for electricity. Milkhouses and dairy barns were usually wired for electricity but ordinarily other farm buildings were not served. Costs of installing the electricity averaged $83 per farm. Most of the farms were wired before World War II when prices were lower than at the time of study. On the average, the farms consumed 2,139 kilowatt-hours of electricity in 1948; and rural nonfarm residences 1,851. The trend in consumption per farm was upward, increasing at the average rate of 14.7 percent a year. An estimated 10.6 percent of the electricity consumed on these farms in 1948 was for farm-production purposes and the rest was used for household purposes. Tenure of operator, type, and size of farm, income, and date of electrification affected the amount of electricity used in 1948. Owner-operators used more than farm tenants or landlords. Livestock farms used much more than any other type of farm. The number of kilowatt-hours increased on all types of farms as acreage in the farm increased. As might be expected, farmers with the largest incomes used the most electricity. The length of time the farm had been electrified also affected consumption, with the number of kilowatt-hours used increasing 190 for each year of electrification. Changes in farming that could be attributed to electricity were almost entirely in the livestock enterprise. Only 9 of the 492 farmers reported that electricity was of doubtful or negative value. In about 5 percent of the instances, the use of electricity was limited because of inadequate power. For the electricity used in 1948, these farmers paid an average of $42.63, or 1.99 cents per kilowatt-hour.

Bonser, H. J. PART-TIME FARMING IN THE KNOXVILLE CITY-COUNTRY FRINGE. Univ. Tenn. Agr. Expt. Sta. Bul. 270. Sept. 1957.

This study was conducted and the report prepared as a phase of the studies in part-time farming, land tenure, and rural development by the Department of Agricultural Economics, University of Tennessee. It is a follow-up of a previous study in the same area and reported in Agricultural Experiment Station Bulletin Number 210, "Part-Time Farming in the Knoxvill Farm-Industrial Area of East Tennessee," University of Tennessee (1949). The Southeast Regional Land Tenure Committee counseled in the conduct of the study and assisted in financing the field work.

Boykin, C. C., Jr. FACTORS AFFECTING CONSERVATION ON SHARE-RENTED FARMS, TEXAS BLACKLAND PRAIRIE. Texas Agr. Expt. Sta. Prog. Rpt. 1879. 1956.

Twenty-seven tenant-operated farms cooperating with the Navarro-Hill Soil Conservation District on the Texas Blackland Prairie were studied in 1955-56 to determine the extent of their progress under the district program. All tenure arrangements on the farms studied were 1/3 and 1/4 crop-share. Some agreements also provided for livestock-share enterprises.

Participation in the district program was greater on farms where the tenant assumed the major responsibilities of management. However, more conservation was accomplished on farms where the landowner furnished some conservation equipment, and on farms with larger acreages in cultivation.

Insecurity of tenure was a major obstacle to conservation. The length of time a tenant expected to remain on the farm was more important in conservation accomplishments than the time he had been on the farm. Also, the presence of a livestock-share arrangement was conducive to greater conservation achievement.

Cost-sharing between landowner and tenant was not done on permanent type conservation practices such as terracing and waterway development. Cost-sharing on temporary type practices such as grass seeding and cover cropping was doneon most of the farms studied. Conservation accomplishments were greater on farms where costs were shared in proportion to returns.

Results of the study indicate that farms owned by females made less progress in the district program than did farms owned by males. The age of tenants and landowners was not an important factor in conservation accomplishments.

Collier, J. W., and Smith, R. M. CONSERVATION SYSTEM GIVE HIGHEST YIELDS. Soil and Water. Mar. 1957.

Blackland Experiment Station plots and fields gave highest yields for row crops in 1956 on areas that were in soil conserving small grain and (or) sweetclover during 1955. Corn yielded 38 bushels per acre following phosphated sweetclover compared with 19 bushels for continuous corn.

Over a 5-year period the dryland corn after clover gave an average yield of 50 bushels per acre compared with 40 bushels for continuous corn. With irrigation the comparable averages were 90 bushels for corn after clover and 48 bushels for continuous corn.

With nitrogen fertilization irrigated corn after clover averaged 87 bushels, or 5 bushels more than the 82 bushels for continuous corn. Thus, it is evident that over the 5-year period, 90 pounds of nitrogen fertilizer per acre per year equalized most but not all of the average yield difference between the two systems of growing corn. In this experiment the sweetclover either died from root rot or was plowed in August every year thus preventing excessive depletion of subsoil moisture. In order to be certain that phosphorus was not deficient all plots had annual applications of 450 pounds of 20% superphosphate per acre. Irrigated plots received enough water during May, June and early July to prevent the corn leaves from curling. The corn hybrid used was Texas 30, with corn plants spaced 15 inches apart in 36-inch rows.

Crowe, G. B., and Carns, H. R. THE ECONOMICS OF COTTON DEFOLIATION. Miss. Agr. Expt. Sta. Bul. 552, 26 pp., illus. June 1957

Tests concerned with comparisons between mechanically harvested defoliated and undefoliated fields were conducted from 1953 through 1955. Net returns to defoliation over the test period ranged from a profit of $3.21 per acre to a loss of more than $23 per acre, with 5 of the 7 locations studied indicating losses. Largest contributing factor to the losses was reduction in yield, which amounted to as much as $20 per acre. Greatest gain was reflected in quality, where increases as high as $9 per acre resulted from use of defoliation. Losses for the 7 locations averaged $6 per acre over the 3 years. If only the cost of defoliation, quality, and picker efficiency are considered, the average net return from the practice over the period of study amounted to $0.22 per acre. Of more importance than these averages are the relationships between climate and plant conditions and the effects of defoliation, measured in net returns, at individual locations. Marked economic returns are likely to accrue from the practice of defoliation if cotton is heavily fruited, grows rankly, and matures in the presence of adequate moisture. No such economic returns can be expected from defoliation used on small, drought-stressed, heavily fruited plants, from which a large percentage of leaves have fallen owing to natural causes. Too early defoliation with resulting reductions in yield, excessive boll weevil or other insect damage that restricts the boll load to certain sections of the plant, and a very dry picking season tend to prevent economic returns from defoliation.

Gregory, W. F. ECONOMICS OF PASTURES IN FEEDING SYSTEMS FOR DAIRY COWS. Ala. Agr. Expt. Sta. Bul. 296. June 1955.

Basic farm production and cost data were obtained for 1948-51 on a group of dairy farms in the Piedmont Area of Alabama. These farms were typical of most farms in the area in regard to land resources, nearness to market, and accessibility to technical assistance. The estimated cost of producing sericea with recommended practices was $20.60. Annually seeded crimson clover-rye grass cost $50.04. Costs for other crops, excluding white clover-carpet grass, ranged from $25.17 to $28.40. Estimated annual yields per acre varied from about $5,400 pounds of dry matter from white clover-carpet grass to about 10,400 pounds from white clover-Dallisgrass. Sixty-five percent of the growth of these forages was assumed to be available with a "put-and-take" system. The forages varied considerably in digestibility at different times during the year. By using two forages, one growing principally in warm weather and one in cool, up to 80 percent of the annual requirements of nutrients for a herd could normally be supplied. Even so, about three-fourths of a ton of concentrates of 1-1/4 tons of hay would be needed per cow annually.

Hansen, P. L., and Mighell, R. L. ECONOMIC CHOICES IN BROILER PRODUCTION. U. S. Dept. Agr. Tech. Bul. 1154. Dec. 1956.

Production of commercial broilers has greatly expanded during the last 20 years. Production problems of broiler producers involve economic choices, which are complicated by the short life cycle of the birds and technical limitations. Broilers reach market weight in a few weeks so that several lots of the birds can be raised with the same fixed resources in the course of a calendar year. Programming of alternative choices involves consideration of the economic choices open to producers in view of the physical and biolgocial limitations of the different systems of operations. The most profitable market weight is interrelated with number of birds per lot and number of lots per year possible within time, space, and labor limitations. In intermittent lot production, the most profitable market weight for broilers is higher than in continuous production. Labor limitations affect the most profitable weight in continuous production more than do space limitations. Usually production of mixed or straight-run chicks is more profitable than production of cockerels and pullets in separate lots. Key business firm in the broiler industry apparently is the feed-dealer supplier. The feed dealer usually supplies feed, chicks, and other materials, and makes mot of the business decisions, although growers retain some of the attributes of independent operators. Programming procedures similar to those used by producers can be used by feed dealers to help determine the most profitable production choices.

Hole, E., and Bondurant, J. H. TOBACCO-LIVESTOCK FARMING, BLUEGRASS AREA OF KENTUCKY, COSTS AND RETURNS, 1954. U. S. Dept. Agr. Agr. Res. Serv. ARS 43-16. June 1955.

Net cash farm income on commercial family-operated tobacco-livestock farms in the Bluegrass Area of Kentucky increased moderately from 1953 to 1954. In 1954, net farm income on small tobacco-livestock farms averaged $2,375; on medium-sized farms, $3,205; and on large farms, $4,385, or $3,440 for all. Production of Burley tobacco was about 14 percent larger than the year before although the acreage harvested was smaller. Receipts from sales of tobacco averaged about $4,015 per farm as compared with $3,750 in 1953. The ratio of prices received to prices paid was 81 in 1954 as compared with 89 in 1953. Total cash production expenditures per farm were higher than in 1953. Wage rates paid to hired labor averaged around 56 cents per hour, and estimated net returns to croppers for labor performed 61 cents per hour. Returns per hour for operator and family labor and management averaged 73 cents on small, 77 cents on medium-sized, and 84 cents on large farms.

Hughes, W. F. CHANGES IN INVESTMENT AND IRRIGATION WATER COSTS, TEXAS HIGH PLAINS, 1950-54. Tex. Agr. Expt. Sta. Bul. 828. Mar. 1956.

Substantial changes occurred in the conditions that affect irrigated farming on the Texas High Plains during the drought and near-drought of 1950-54. The number of irrigated farms, wells, acres irrigated and amount of water used, both total and per acre, have increased materially. In the surveyed area, one or more wells were added on 55 percent of the old farms. In the sandy-land area, wells cost an average of $4,730 as compared with $6,642 in the heavy-land area. Wells on new farms cost an average of $800 more than wells developed on old farms. The 1954 average water cost per acre more than doubled the 1947-49 average. As the per acre cost of water increases sharply as the acreage irrigated per well drops below 71 to 90 acres, the 1950-54 decrease of 26 percent in acres irrigated per well suggests that water costs may be expected to increase, especially in the sandyland area. Future efforts should be centered on water conservation, with perhaps a shift to less intensive water-use practices. Overall farm irrigation costs need to be reexamined, with emphasis on the break-even point under present modified water-use practices and future price levels.

Ibach, D. B. USE OF STANDARD EXPONENTIAL YIELD CURVES. U. S. Dept. Agr. Agr. Res. Serv. ARS 43-69.

Economic interpretation of yield response to fertilizers based on use of standard exponential yield curves can be accomplished with a few calculations that involve only simple arithmetic. The method is useful to teachers, extension workers, researchers, or anyone interested in the economics of fertilizer use. Even those who are familiar with complex mathematical procedures can save time by using the standard curves. Fitting the curve does not require the use of a computing machine. However, a machine or a slide rule is needed in finding the most profitable rates of application and in related calculations.

Krider, D. E., and Dellberg, R. A. WOODLAND CONSERVATION AROUND MONTEREY BAY. Jour. Soil and Water Conserv. 12: 112-114. 1957.

The authors tell something of the past that trees have played in the history--and conservation--of the Monterey Bay area in California.

Myers, K. H. AN ECONOMIC APPRAISAL OF GREEN CHOP FEEDING. Pa. Agr. Expt. Sta. Prog. Rpt. 170, 8 pp., illus. April 1957.

Twenty Pennsylvania farmers who were using this practice in 1954 were visited to find the extent to which they were green chopping and to learn their experiences and the results obtained. Computations made in the study indicate that green chopping on a typical Pennsylvania farm would permit addition of 3 cows to the herd. The operator's labor income would be increased by about $600 if he already owned a field forage harvester. If it is necessary for him to buy a new machine, he would increase his labor income by about $400.

North Central Farm Management Research Committee, Subcommittee on Diverted Acres. FARMERS' REACTION TO ACREAGE ALLOTMENTS. Lexington, Ky., Kentucky Agr. Expt. Sta. Dec. 1955.

The reactions of farmers in the North Central States to acreage allotments on corn and wheat were obtained in the summer of 1954 from a sample of farmers in each of six States. The number of farmers who complied with the 1954 corn acreage allotments ranged from 15 percent in Michigan to about 67 percent in Iowa. Sixty percent of the farmers in Iowa who complied with the allotments said they did so in order to be eligible for price support; only about a third of those in other States who complied gave this reason. The chief reason given by Ohio, Indiana, and Kentucky farmers who complied was that their allotments were equal to or greater than the acreages of corn they had planned to plant. By far the chief reason for not complying was that corn was needed for feed. The proportions of farmers who complied with their wheat acreage allotments varied greatly among the six States. Compliance in Kansas was 99 percent complete. Lowest percentages of compliance were in Indiana and Michigan, where only a little more than half of the wheat producers complied. The two outstanding reasons given for complying with wheat allotments were to be eligible for price support and to avoid payment of a penalty. Reasons given for not complying with wheat allotments varied among the States. In Ohio, Indiana, and Michigan, a number of farmers said they did not comply because they did not wish to disrupt established rotations or because their allotments were too small. In Ohio, Michigan and Kentucky, many did not comply because they used their wheat for feed, and with fewer than 15 acres of wheat they were not subject to penalty for noncompliance. The percentage reduction in acreage of wheat was greater than in corn because marketing quotas were in effect for wheat. Acreages were reduced less in Kansas than in the other wheat States. Changes in acreages of corn because of allotments varied among the States concerned. In Ohio, Indiana, Kentucky, and Michigan, where much corn is fed, the effect of allotments was to increase acreages. In Iowa, where much of the corn is grown as a cash crop, the acreage was reduced by 10 percent.

Rogers, R. H., and Campbell, J. R. AN ECONOMIC ANALYSIS OF LAND CLEARING AND SUBSEQUENT CROP PRODUCTION IN THE CORPUS CHRISTI AREA. Tex. Agr. Expt. Sta. Prog. Rpt. 1628. Nov. 11, 1953.

In June 1952, 61 farmers were interviewed regarding their experiences in clearing nearly 8,500 acres of brushland in the area. The farms averaged 690 acres in size and varied from 100 to 3,100 acres. Land cleared and reported on in the study ranged from 12 to 612 acres and averaged 138.5 acres per farm. All of this land was planted to crops as soon as possible after clearing. Most of the clearing was done from 1947 through 1949, and no farms were included in the study on which clearing was done later than 1950. Most of the clearing was done under contract by individuals who operated economic units of large machinery, each of which required an investment of around $75,000. The average charge for custom clearing was $35.50 per acre, and an additional $5.50 went to hand labor for picking up roots. Cotton was planted on the newly cleared land by 39 of the 61 farmers; 20 of them planted grain sorghum; and others planted flax and such feed crops as Sudan, hegari, and red-top cane. Before clearing, the land was valued by the owners at an average of $91.60 per acre, with the valuation ranging from $26 to $200 per acre. After clearing, the estimated value ranged from $100 to $350 per acre as cropland and averaged $230 per acre. Thus, for an average clearing cost of $41 per acre, estimated acre values were increased by $138, in the opinion of the cooperating farmers.

Sitler, H. G. ECONOMIC POSSIBILITIES OF SEEDING WHEATLAND TO GRASS IN EASTERN COLORADO. U. S. Dept. Agr. Agr. Res. Serv. ARS 43-64. Feb. 1958.

The study reported here deals with the costs and returns of seeding cropland to grass in the eastern Colorado wheat area north of the Arkansas River. In this semiarid plains area, approximately two-fifths of the land is under cultivation and three-fifths is in pasture. Since 1929, the acreage of cultivated land here has increased from 2.8 million to 4.2 million acres.

Farmers have been more successful in establishing grass on sandy than on heavy lands. Even so, a successful stand of grass is not always obtained with one seeding. It is not unusual to reseed up to half of the acreage that was first seeded 2 or 3 years earlier. After the grass is fully established, farmers estimate that these pastures have about two-thirds more carrying capacity during the first 10 years than adjoining native pastures.

Sitler, H. IRRIGATED PASTURES IN NORTHEASTERN COLORADO, 1950-1951. A PRELIMINARY PROGRESS REPORT. (RMA Report) Nov. 1952 (March 1953)

This report is based on information furnished by 85 farmers in northeastern Colorado who had one or more irrigated pastures in 1950 and 1951. Some were annual pastures but most of them were rotation pastures, that is, they were seeded to perennial grasses and legumes and used for several years. Both kinds were irrigated. The typical cost per acre of establishing rotation irrigated pastures amounted to $32.30; the average cost was $35.97. These costs included costs of tractor work, seed, fertilizer, irrigation, and miscellaneous costs. The cost of water and labor to irrigate an acre of rotation pasture when the water supply was adequate, using sprinklers, averaged $16.10 for 1950-51. Using wild flooding, the cost was $12.19; using border flooding, it was $12.54. With an inadequate water supply, and using wild flooding, it averaged $12.12. The average cost of maintaining an acre of irrigated pasture averaged $23.33 for the 2 years. In terms of cost, the choice between annual and rotation pastures depends on how long the rotation pasture is to be used. If it is to be used for only 2 years, annual pasture seeded each year is more economical than rotation pasture. If for 3 years, the average annual cost is about the same for either kind. If for 4 years or longer, the rotation pasture will provide grazing at lower cost.

Snare, J. L. FARM RENTAL ARRANGEMENTS IN ALABAMA'S PIEDMONT. Ala. Agr. Expt. Sta. Bul. 303. (Southeast Land Tenure Res. Comm. Pub. 23.)

Information in this bulletin was obtained by interviewing 370 farm tenants and owners in Chambers, Clay, Cleburne, Coosa, Lee, Randolph, and Tallapoosa Counties. Purposes were to learn the farm leasing practices in the Piedmont Area of Alabama; to find the relationships that exist among farm organization, income, production efficiency, and principal types of tenure in this area; and to evaluate probable effects of leasing practices on efficiency and income. The most common tenancy arrangements found were cropper and share, followed in order by cash, part owners, standing, and miscellaneous. Few provided for compensation to tenants for improvements, and none for compensation to landlords for abuse of property. Average occupancy of farms was 6.2 years for tenants, as compared with 15.6 for owner-operators. Production efficiency was higher on the larger farms. In labor efficiency, owner-operators were highest. Whole farm earnings were related to size of farm and formal educational level of the operator. Leases were rated on five general characteristics: Clarity, security of tenure, flexibility of farm organization under the lease, equitability, and rent-income ratio stability. Clarity of leasing arrangements was found to be most important in this area. Farms were too small and farm capital was inadequate for efficient and economical units. Absence of livestock farms among tenants indicated that something about rental arrangements retarded adjustments or changes. What the something was could not be learned.

Taylor, C. C. FARM REAL ESTATE ASSESSMENT IN GEORGIA. Ga. Agr. Expt. Sta. Bul. n.s. 22. April 1956.

Assessment-sale ratios of 1,720 farm real estate transfers made in 1951, 1952, and 1953 in 14 Georgia counties showed serious inequalities in the assessment of this type of property for tax purposes. Assessment-sale ratios varied significantly between counties and between individual properties within counties. Assessment bias was related closely to the quality and total value of taxable property. Properties of better-than-average quality tended to be underassessed and those of less-than-average quality to be overassessed. The widely varying assessment ratios apparently are the result of an inadequate assessment system. In the absence of enough time, facilities, and standardized methods of evaluating property with a reasonable degree of accuracy, poorly paid part-time assessors with limited training must rely to a large extent upon average values in making mass assessments. Inequalities are inevitable. A more realistic system based on a scientific accumulation of factual data describing all taxable property is needed.

Tippit, O. J., and Jones, J. H. SOIL CONSERVATION MANAGEMENT SYSTEM FOR BEEF PRODUCTION IN THE BLACKLANDS OF TEXAS. Tex. Agr. Expt. Sta. Misc. Pub. 90. March 1953.

Experimental results on Houston Black and Austin clay soils at the Blackland Experiment Station at Temple during the past 8 years have shown the value of erosion-resisting and soil-improving crops when measured in per-acre gain of beef steers.

Information obtained from a number of practical field-scale grazing trials with grasses, small grains and legumes is given in this publication. An individual producer can adapt the basic principles to his own type of livestock, farming system and land. Texas Station Miscellaneous Publication 65, "Research Sets Patterns for the Central Blacklands," previously described conservation management systems for the Blacklands.

Woodworth, R. C., and Saunders, F. B. EVALUATING INCOME OPPORTUNITIES ON NORTH GEORGIA FARMS. Ga. Agr. Expt. Sta. Bull. N. S. 34. Oct. 1956.

The task of evaluating opportunities is a complex undertaking for the farm family. The appropriate solution varies greatly from farm to farm and from manager to manager as basic resource and price-cost situations change. When nonfarm employment opportunities are also considered in conjunction with farm opportunities, the variety and complexity of situations within which farm families must make decisions greatly increases.

The major emphasis in this study is on the procedures of evaluation which can be applied to specific situations. Specifically, the study covers the following three phases of evaluating income opportunities.

1. A systematic procedure for the evaluation of income opportunities on North Georgia farms is developed and illustrated.
2. The procedure is applied to a variety of commercial and part-time farming situations for a case-study farm.
3. Important relationships between kind and amount of resources; kind and amount of alternative uses for resources, prices, cost, and nonfarm wage rates are delineated and their effects on resource allocation and income are illustrated.

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